Volume 16 FEBRUARY, 1930 *No. 2*

BITUMINOUS COAL NUMBER

Featuring the operations of
THE UNION PACIFIC COAL COMPANY

The Bituminous Coal Industry in 1929
Ten Years of Mechanical Loading
Modern Mine Management

Research and Uses for Coal
Trends in By-Product Gas and Coke Industry
Heating Coke Ovens with Blast Furnace Gas
Increased Production with Mechanized Loading

—Nevada Consolidated Copper Company—

Mining Methods at Ray Mines
The Hayden Concentrator
Adjustable Pneumatic Brattice

Contributors:

C. P. White, Harry L. Gandy, Thomas S. Baker, L. E. Young, Ernest L. Bailey, C. J. Ramsburg, J. L. Davidson, J. D. Zook, C. J. Neekamp, Frank Hall, H. E. Nold, E. W. Smith, Benedict Shubart, Carl J. Fletcher, G. B. Southward, F. B. Thacher, C. A. Kumke, V. T. Berner, W. I. Garms, Eugene McAuliffe, and twenty-four additional contributors under The Union Pacific Coal Company Section.

SAFETY
cannot be purchased..

The Safety of underground workers cannot be bought in the market place—but depends primarily upon the attitude of the management.

An inherently harmless machine or method may easily become a menace if carelessness is tolerated—or ignorance permitted to remain uninstructed.

One of the finest and most commendable attributes of present day mine management is its tendency to be 100% "safety-minded"; and its consequent efficiency in guarding employees against unnecessary injury because of ignorance or short-sighted recklessness.

Under such management blasting becomes as free from danger as any other mining operation—because both the materials and the method of procedure are inherently safe; and can only become dangerous through ignorance or recklessness on the part of the worker.

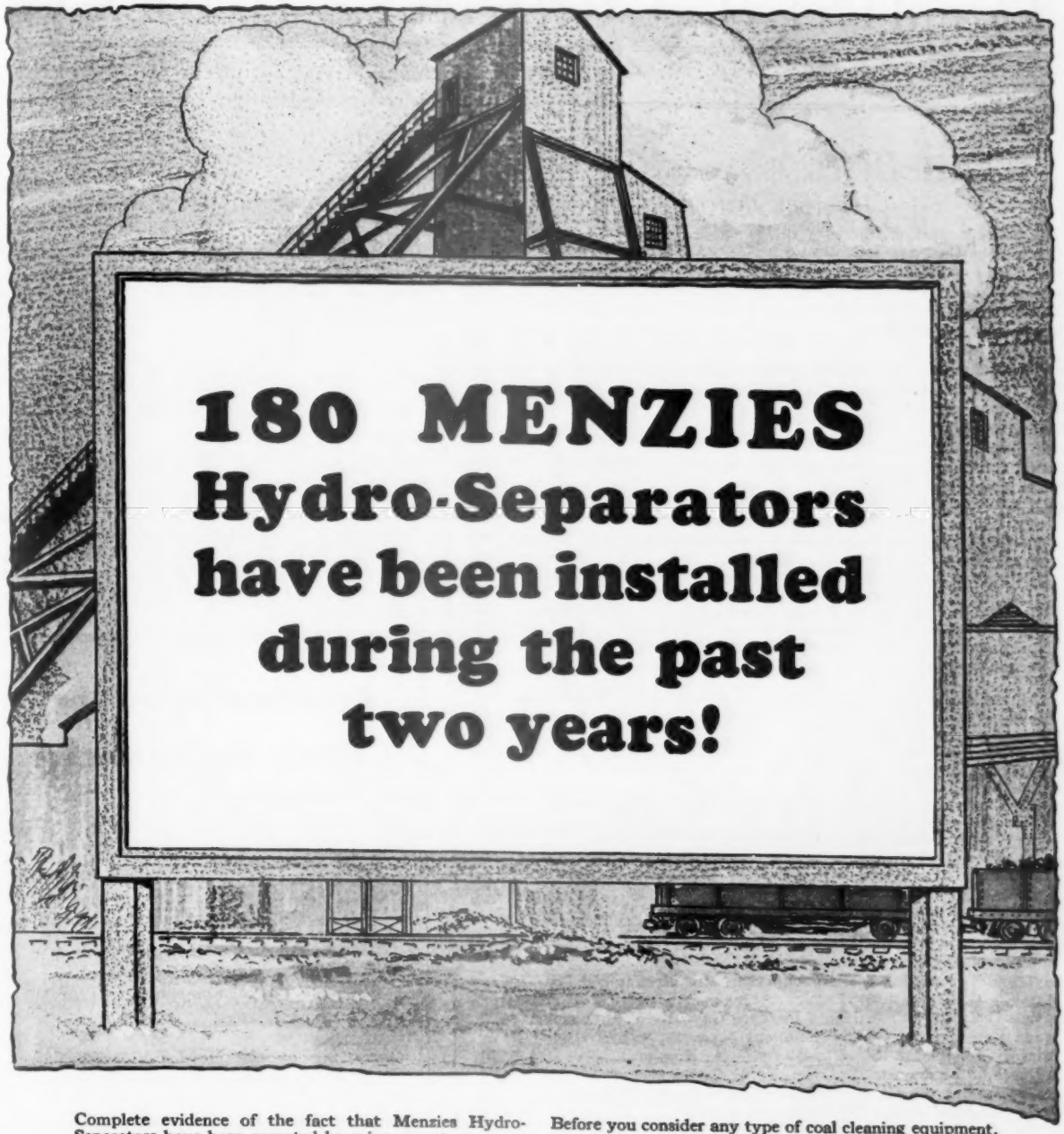
As the original manufacturers of Safety Fuse we pledge continued and unremitting devotion to the cause of safe blasting; and bespeak the cooperation of all mining executives, through insistence upon proper procedure in the use of explosives.

Do Not "Short Fuse" --Fuse should be cut long enough for the end to extend well out of the mouth of the bore hole when the primer cartridge is in place.

All holes should be well tamped.

THE ENSIGN-BICKFORD CO.
SIMSBURY **CONNECTICUT**

THE ENSIGN-BICKFORD CO. 1836 SAFETY FUSE 1929 SIMSBURY, CONN.



Complete evidence of the fact that Menzies Hydro-Separators have been accepted by mine operators everywhere—and proof of our claims that they have been proved by actual field operation the most economical medium for wet cleaning of large sized coals.

More than 11,000,000 tons are cleaned annually with Menzies Hydro-Separators, which offer you simple, properly designed, ruggedly constructed, automatic equipment that is highly efficient and truly trouble-proof.

Elimination of hand picking of egg and nut sizes, and the resultant saving in labor costs of from 10 to 20 men, according to the tonnage handled and the amount of impurities in the coal, is accomplished by the use of the Menzies Hydro-Separator.

Before you consider any type of coal cleaning equipment, investigate the RandS Method of Coal Cleaning which employs the Menzies Hydro-Separators for cleaning large sized coals and Arms Air Concentrating Tables for fine sizes. May we send you complete data contained in Bulletin No. 110?

RandS Coal Cleaning, Preparing and Handling Equipment includes Marcus Picking Table Screens, RandS Rotary and Gravity Type Car-Dumpers, Arms Horizontal Vibrating Screens, RandS Car Feeders and Spraggers, Arms Air Concentrating Tables, Menzies Hydro-Separators, Apron Loading Booms, etc., with a complete tipple and cleaning plant engineering service.

ROBERTS AND SCHAEFER CO.

ENGINEERS AND CONTRACTORS

PITTSBURGH, PA., 418 OLIVER BLDG. WRIGLEY BUILDING, CHICAGO HUNTINGTON, W. VA., 514 NINTH AVE.

The MINING CONGRESS JOURNAL

VOLUME 16 | FEBRUARY, 1930 | No. 2

Contents

FEATURE ARTICLES

EDITORIALS

DEPARTMENTS

Practical Operating Men's Department

COAL

Heating Becker Coke Ovens With Blast Furnace Gas

METAL

Recent Changes in Mining Methods at Ray Mines, Nevada Consolidated Copper Company

Adjustable Pneumatic Brattice

Operations at the Hayden Concentrator, Nevada Consolidated Copper Company

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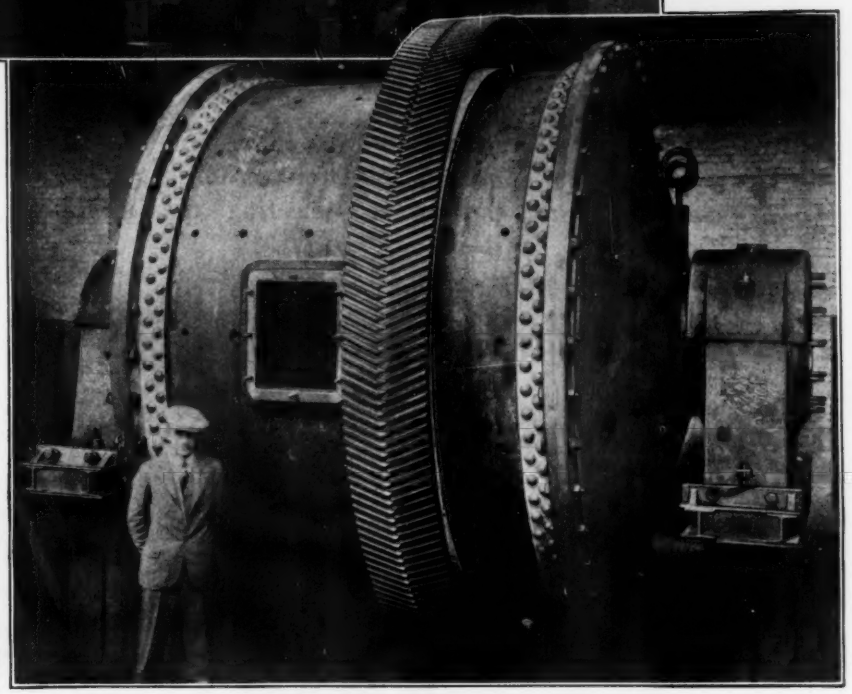
9′ x 12′ Rod Mill for Nevada Consolidated Copper Company.



One of six 10′6″ x 8′ Ball Mills for Miami Copper Company.

Grinding Mills *of* Record Size

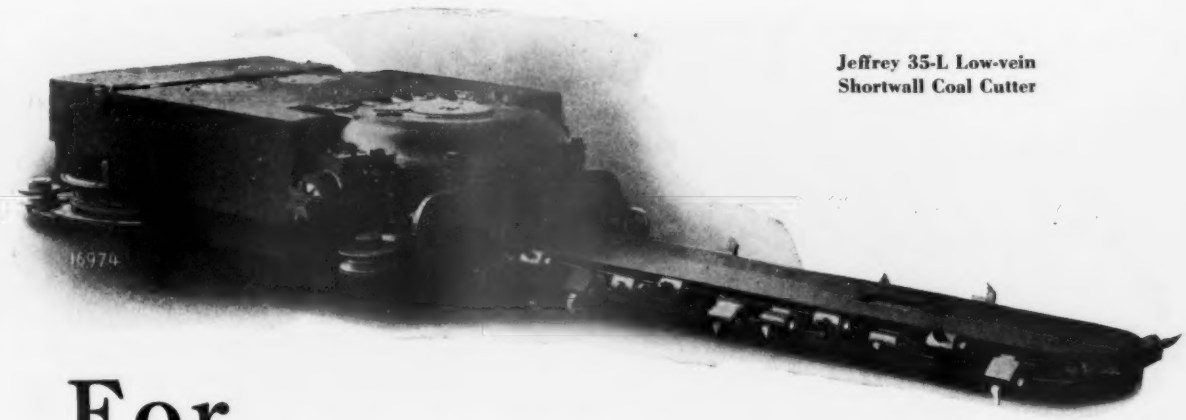
LARGE size units lower production costs. That is why the leaders in the mining industry are adopting large mills.

The two mills shown above exemplify Allis-Chalmers leadership in developing and building large mills. The demonstrated success of these mills in daily operation again proves the soundness of design and construction and the high quality of workmanship and materials in Allis-Chalmers grinding mills.

Let Allis-Chalmers engineering experience and unsurpassed manufacturing facilities be of service in reducing your grinding costs.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee



Jeffrey 35-L Low-vein
Shortwall Coal Cutter

For Low Coal

THE features of simple rugged construction, few gears, convenient location of operating levers and wheels, found in the Jeffrey 35-B and 35-BB Shortwall Machines are also found in this new Jeffrey 35-L Low-vein Shortwall.

The machine is equipped with a 50-HP. motor. Cutter bars are of standard lengths.

The feed and handling drums may be operated separately or simultaneously. Both drums are provided with a fast speed and a slow speed. This arrangement enables the machine runner to maneuver the machine easily in any desired manner.

The complete control is mounted in a compartment in the side of the machine. A complete description of this new Jeffrey 35-L Low-vein Shortwall Machine will be gladly sent on request.

All controls are located at the rear left-hand corner of the machine as shown above. This concentration of control is especially important for convenient and efficient operation in low coal.

THE JEFFREY MANUFACTURING COMPANY

958-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES:

New York, Charleston, W. Va., Philadelphia, Denver, Salt Lake City, Pittsburgh, Birmingham, Scranton, Pa., Chicago

SALES AND SERVICE STATIONS:

Birmingham, Ala., 1911 Avenue A. Terre Haute, Ind., 319 Cherry St. Pittsburgh, 600 Second Ave. Winchester, Ky., 122 N. Main St. Scranton, 122 Adams Ave. Salt Lake City, 153 W. Second South St.

JEFFREY MFG. CO., LTD., OF CANADA: Head Office and Works, Montreal; Branch Office, Toronto; Service Station, 210 Ninth Ave., W., Calgary

JEFFREY COAL MINE EQUIPMENT

A Driving Chain That's Easy To Accurately Adjust

Bill: You know what a job it is on some machines to tighten the driving chain between the two axles?

Skinny: I'll tell the cock-eyed world I do! I have been crawling under machines and crouching down in pits to tighten up them chains until I have got corns all up an' down my back.

Bill: On this machine you put a crank on the end of the shaft and turn it. That moves one of the axles until the chain is tightened, and in this way the axles will always be square with the machine. In some other machines you have got to be careful so that you don't tighten up one side more than the other, and then the wheels don't track right.

Skinny: Talkin' about them corns on my back, I don't know whether that kid of mine is half-witted or just plum ignorant. His teacher ast him what the spine wuz, an' he said it was a bone that bends easy, an' on top of it sits the head, an' you sit on the other end.

The Jeffrey 29-C Arcwall Coal Cutter and other Jeffrey Mining Equipments are completely described in Catalog 475-C. May we send you a copy?

The Jeffrey Manufacturing Company

958-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES:

New York, Philadelphia, Pittsburgh, Scranton, Pa.
Charleston, W. Va., Denver, Salt Lake City, Birmingham, Chicago

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JEFFREY MFG. CO., LTD., OF CANADA:

Head Office and Works Montreal; Branch Office Toronto; Service Station, 210 Ninth Ave., W. Calgary

JEFFREY COAL MINE EQUIPMENT

BITUMINOUS COAL MINING EQUIPMENT

THE NEW UNIVERSAL SHAKER LOADER

AND

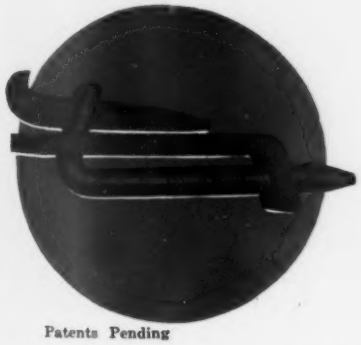
Duckbill
TRADE MARK

11 PATENTS GRANTED AND PENDING IN UNITED STATES, CANADA AND EUROPE

George H. Ernsbarger, Frank L. McCarty, James V. Macdonald, the inventors of the "Duckbill."

The MacHatson Trough Fastener

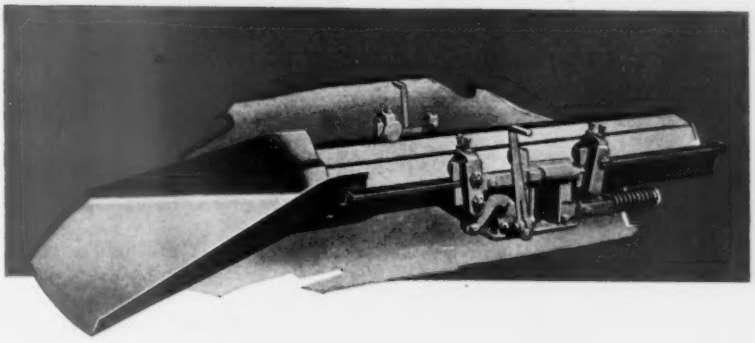
Takes the place of the bolt and two nuts formerly used.
No threads to batter and strip.
No special wrench to lose in the coal.
Goes on with the tap of a hammer, off same way.
Fits Cosco, Eickhoff, Mavor and Coulson, and Flottmann troughing.
Saves time, money and your temper.



Patents Pending

What the "Duckbill" Will Do

Eliminate hand shoveling of coal and rock. Work under apparent impossible roof conditions. Admit of cleaning the coal in the working place. Eliminate room switches and room tracks. Loads each pit car without uncoupling from trip. Works in entries, rooms and on pillars; but one type of machine. Will work in seams as low as 22 inches thick.



The Universal Shaker Loader and "Duckbill" is designed to be attached to the inbye end of any substantially constructed reciprocating shaker trough conveyor, whether operated by electric or compressed air drives. It can be purchased direct from the Rock Springs Loader Company or from any manufacturer or distributor of jigging or shaking conveyor.

Address the Company or any of our Distributors

ROCK SPRINGS LOADER CO.

ROCK SPRINGS
WYOMING

Sole owners and manufacturers

Conveyor Sales Company, Inc.
299 Broadway, New York

C. H. McCullough Engineering Co.,
Oliver Bldg., Pittsburgh, Pa.

The Vulcan Iron Works Co.,
Denver, Colorado.

Peacock Brothers, Ltd.
Montreal, Canada.

Meco Incorporated,
700 Continental Bldg.,
Baltimore, Maryland

The Ironton Engine Co.,
Ironton, Ohio.

Eickhoff Brothers,
116 Adams Avenue,
Scranton, Pennsylvania.

The Joy Loader Never Becomes Obsolete!

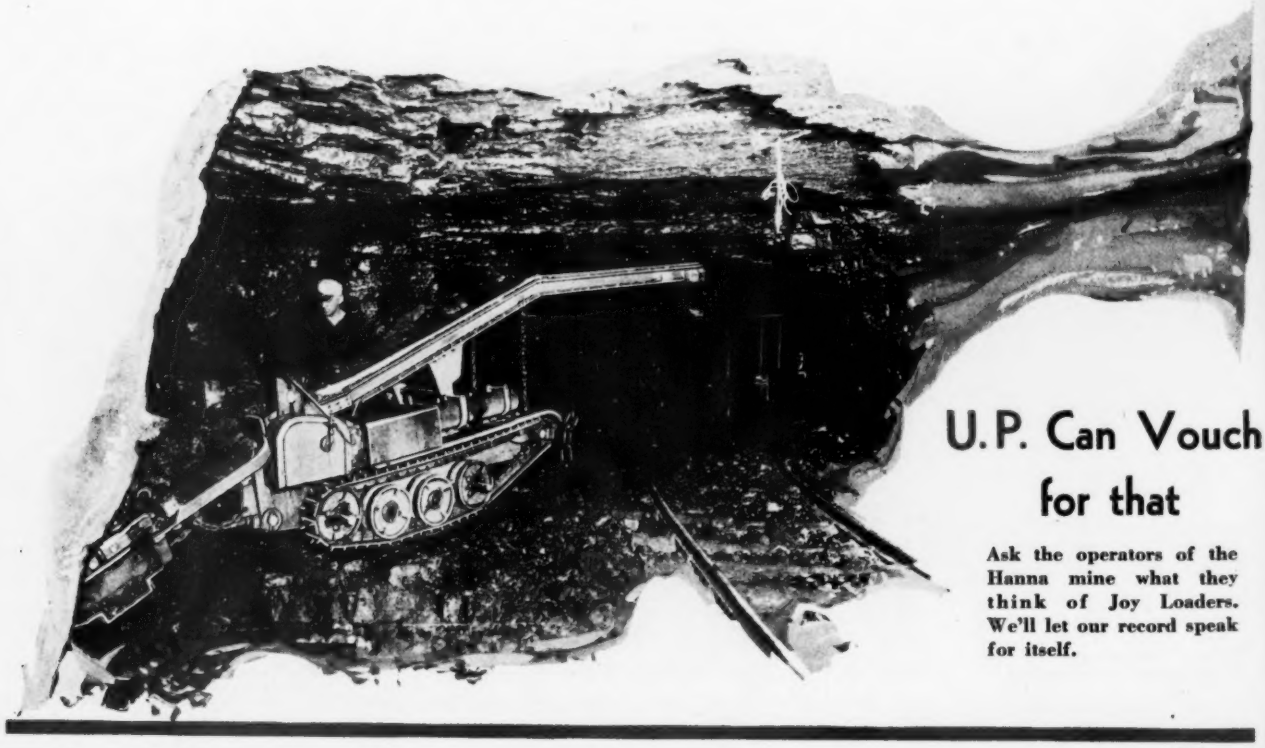
In 1923, two Joy Loading Machines of the 4 B U Type were installed at the Hanna mine of the Union Pacific Coal Company. They are still in operation!

Seven years of almost continuous service is the best thing that U. P. can say about Joy Loaders—yet. But these two 4 B U 's are still going strong.

In 1928 the 5 B U Type Joy Loading Machine was introduced. Seven of these machines are now in operation at the Hanna mine, where they have proven entirely practical and efficient even under such severe operating conditions as are found at this property.

The OLD

Below is an actual photograph, made only a few weeks ago, of one of the original 4 B U Type Joy Loading Machines. This machine was installed at the Hanna mine of the Union Pacific Coal Company, in 1923, and is now in operation at the Winton mine in a 15 degree slope.

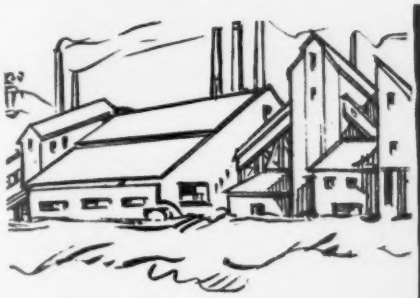


U.P. Can Vouch for that

Ask the operators of the Hanna mine what they think of Joy Loaders. We'll let our record speak for itself.

B-6.

BITUMINOUS COAL MINING EQUIPMENT



The NEW

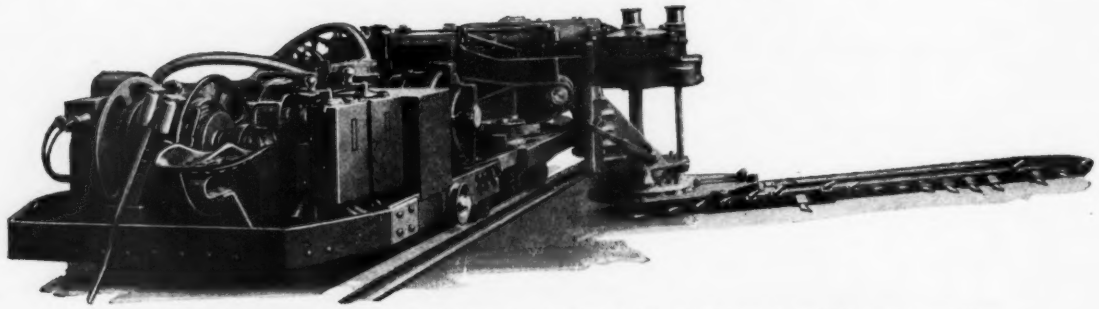
This 5 B U Type Joy Loader was placed in service at the Hanna mine in 1928.

The Joy Mechanical Loader has proven itself the most practical, efficient and economical machine yet designed. Every improvement that would increase the mechanical and operating efficiency of this equipment has been employed, with the result that the Joy Loader, as at present manufactured, meets every requirement of coal mine loading.

JOY JOY MANUFACTURING CO., FRANKLIN PENNA.

LOADERS

Undercutting Com

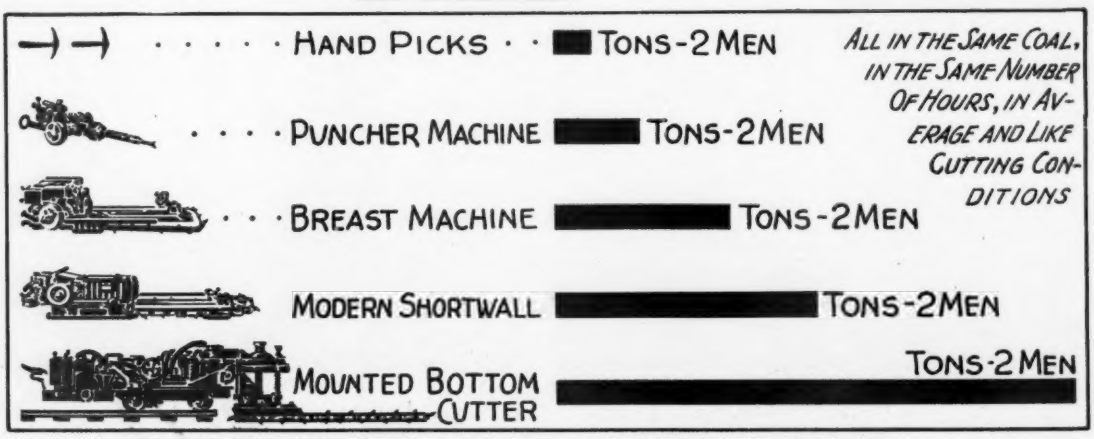


GOODMAN MOUNTED BOTTOM CUTTER—UNDERCUTS DIRECTLY FROM THE TRACK.
Cutting heights (bottom of kerf): from 8 in. below to 7½ in. above rail tops.
Cutting widths (standard 7 ft. cutter arm): 10 to 28 ft.

The Latest Big Development in Underground Equipment

You Gain—	Because—
More Places Cut	The Goodman Mounted
In Less Time	Bottom Cutting Machine
With Less Labor	Undercuts the Face
With Greater Safety	Directly from the Track

Mechanize YOUR Undercutting!



STAGES OF ADVANCEMENT FROM EARLY DAYS TO THE PRESENT TIME
Tonnages approximately doubled with each succeeding type.

pletely Mechanized

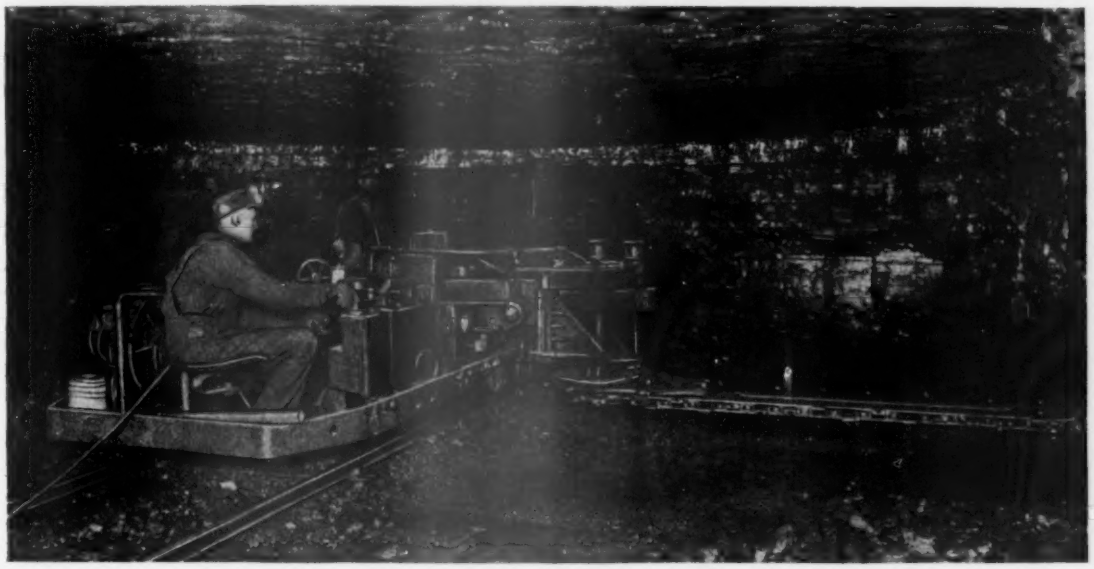
By the Goodman Mounted Bottom Cutter

The Strongest Bottom Cutting Machine Ever Built —and Has the Greatest Cutting Capacity—

Previous types of successful undercutters—transported by truck and unloaded for operation at the face—have been merely progressively better and better *tools* in the hands of the miner. None could be considered as completely mechanizing the undercutting operation. With the Mounted Bottom Cutter, however, we leave the tool class behind and enter the class of full-functioned machinery.

Because of its unhampered ruggedness of construction and its completeness of operative adaptability, the Mounted Bottom Cutter shows a marked increase of productive capacity and an important decrease of maintenance costs as compared to the most advanced type of shortwall.

The Goodman Mounted Bottom Cutter has been designed with full freedom to incorporate all the features which experience with other cutters has proved really desirable. It is a complete machine, completely mechanizing the work of undercutting.



READY TO CUT A PLACE 28 FT. WIDE

Features Acclaimed by Men of the Mines for the Goodman Mounted Bottom Cutter

1. Its tremendous cutting strength.
2. Cuts a smooth floor, on the bottom; easily follows irregular bands—because of the simple and positive, but flexible, control of cutterarm.
3. Easy to operate—all operating levers conveniently located.
4. Safe, because cutting swing is geared—not swung by unreliable and troublesome ropes.
5. Stays on the track when tramming—three point frame support.
6. Easy to maintain—armatures, controllers, rheostats and complete gear trains quickly accessible.

Book M-292, just issued, covers all features. Write for a copy. (18)

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
CHICAGO - - - ILL.

Locomotives - Loaders - Coal Cutters

PITTSBURGH-WILKES-BARRE-HUNTINGTON,W.VA.-CINCINNATI-BIRMINGHAM-ST.LOUIS-DENVER-PRICE, UTAH

Right: A sub-station at Rock Springs power house. Transformer bushings and insulators carry the O-B trade mark.

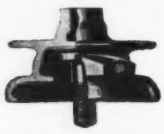
Center: Administration Building at Rock Springs.

Haulage scene at No. 8 Mine of the Union Pacific Coal Company, Rock Springs, Wyoming. O-B Line Materials are used throughout.

One of the 33 K. V. sub-stations feeding this mining property. O-B Materials are also used here.

O-B Bulldog Trolley Clamp

The dependability and the many refinements of this clamp have given it a world wide reputation as a cost reducer. Described on page 33, O-B New Products Supplement No. 3.



K-3 Mine Hanger

Service records prove these hangers give 20 to 25 years of service. Complete line shown on pages 483 to 496, O-B Catalog No. 20.

Type AW-12 Rail Bond

The internal copper sleeve, the right terminal design, the proper lay in strand, are but a few of the reasons why O-B Bonds are on the rail long after ordinary bonds have failed. 63 pages of the O-B Catalog are devoted to describing rail bonds.

Successful Efforts to Reduce Costs Have Put U. P. in the Lime-light

THE spot-light of favorable attention is focused on the operations of the Union Pacific Coal Company. It reveals many aggressive efforts to reduce production cost; efforts so interesting and inspiring that many pages of this publication are devoted to recording its achievements.

The men of this company recognize the important role which continuous haulage from face to tipple plays in making big-tonnage and low-costs possible; and no small part of their effort has been directed at this phase of their operations. These men know that stalled trips have no place in the scheme of profitable mining. And the record for tonnage mined at the U. P. Coal Company stands as a tribute to the effectiveness with which coal is kept moving over its haulageways.

It is not strange that one should find O-B Haulage Materials in service at the Union Pacific Coal Company. O-B Materials and uninterrupted haulage most frequently are found together. This is the reason why O-B Materials are used so extensively at U. P.—the reason one finds O-B Materials in service in the many hundreds of mines where men do not gamble against the heavy odds of using untried and unproved line material items.

Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada
11B0M

Ohio Brass Co.

NEW YORK PITTSBURGH PHILADELPHIA BOSTON CHICAGO CLEVELAND ST. LOUIS ATLANTA SAN FRANCISCO LOS ANGELES DALLAS

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES

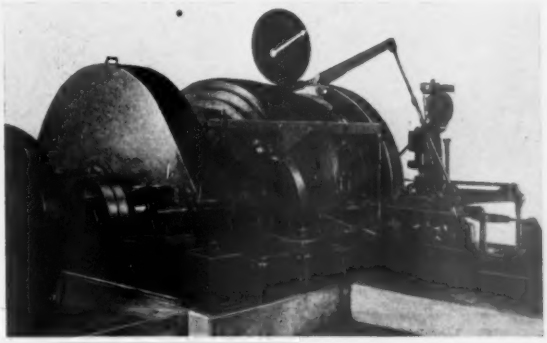
VULCAN DENVER 1891

MINE HOISTS

For SLOPE—SHAFT—GATHERING and ROOM SERVICE

Single and Double Drum

ELECTRIC—STEAM—AIR—OIL—GAS



BULLETIN No. 429

SHAKING CONVEYORS

RUGGED DESIGN—EFFICIENT MOTION

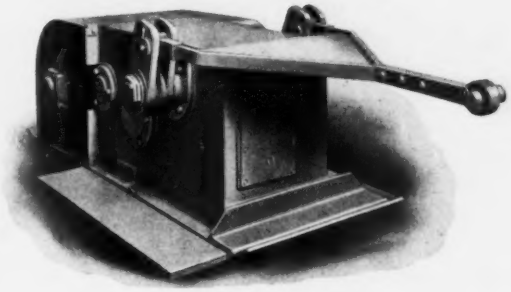
Vulcan Enclosed Electric Drives

of all steel construction

Flottmann Air Drives

Double Acting Type

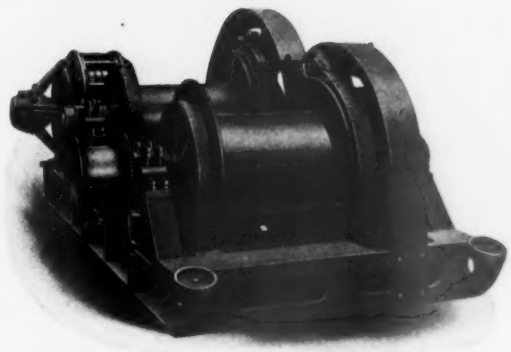
STANDARD TROUGH SECTIONS



BULLETIN No. 435

SCRAPER LOADERS

From FANS TO FACE *at* UNION PACIFIC COAL CO.



Seven duplicating 125-H.P. Loaders of this design at U. P. Mines

A sturdy and reliable job for real production

All steel construction—Herringbone Gears

Flexible coupling connection to motor

Actual production over 700 tons in 6 hrs. per unit

Maintenance under 1/3% yearly in 3 years service

Also made in sizes from 10 H. P.—75 H. P.

ROPE ROLLERS

Over 400 in service at U. P. Mines

Light weight assures quick starting

Timken Bearings minimize friction and lubrication

Chromium steel affords long life

Made in all types—also tail rope sheaves
Moderate in cost

Bulletin No. 115

VULCAN DENVER 1891

THE VULCAN IRON WORKS COMPANY

MANUFACTURERS DENVER ENGINEERS

VULCAN DENVER 1891

BITUMINOUS COAL MINING EQUIPMENT

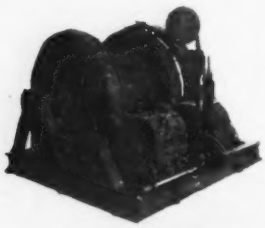
VULCAN

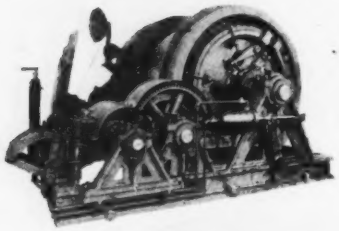
of

WILKES-BARRE

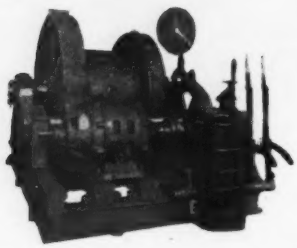
This photograph shows one of two 400 H. P. main and tail rope double friction drum hoists built for the Cranberry Fuel Company, Sprague, West Virginia. This hoist has a capacity of 1,500 gross tons in 8 hours; a rope pull of 4,500 lbs.; it operates on a grade of about four percent pulling 30 cars per trip, at a rope speed of 1,000 feet per minute, an empty car weighing 1,875 pounds, and coal per car 3,200 pounds.

Installations at UNION PACIFIC



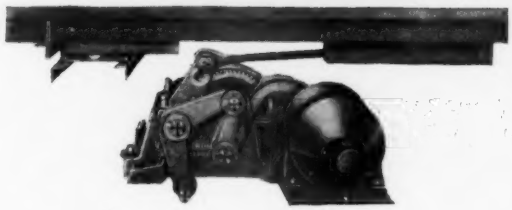


Three Vulcan hoists installed at the Union Pacific Coal Company. The upper two, 100 H.P. and 75 H.P. respectively, were built in 1909 and the one at the bottom in 1920.



Vulcan furnishes many types of equipment for the mining industry including three point suspension locomotives—gasoline, steam and electric; shaker conveyors with flexible shovelers, loading ends, and trough joints; crushers; fans and ventilating equipment; kilns, etc. Write for catalogs.

Vulcan Shaker Conveyors have several unusual features that add to their flexibility and operating ease and efficiency. Write for catalog.



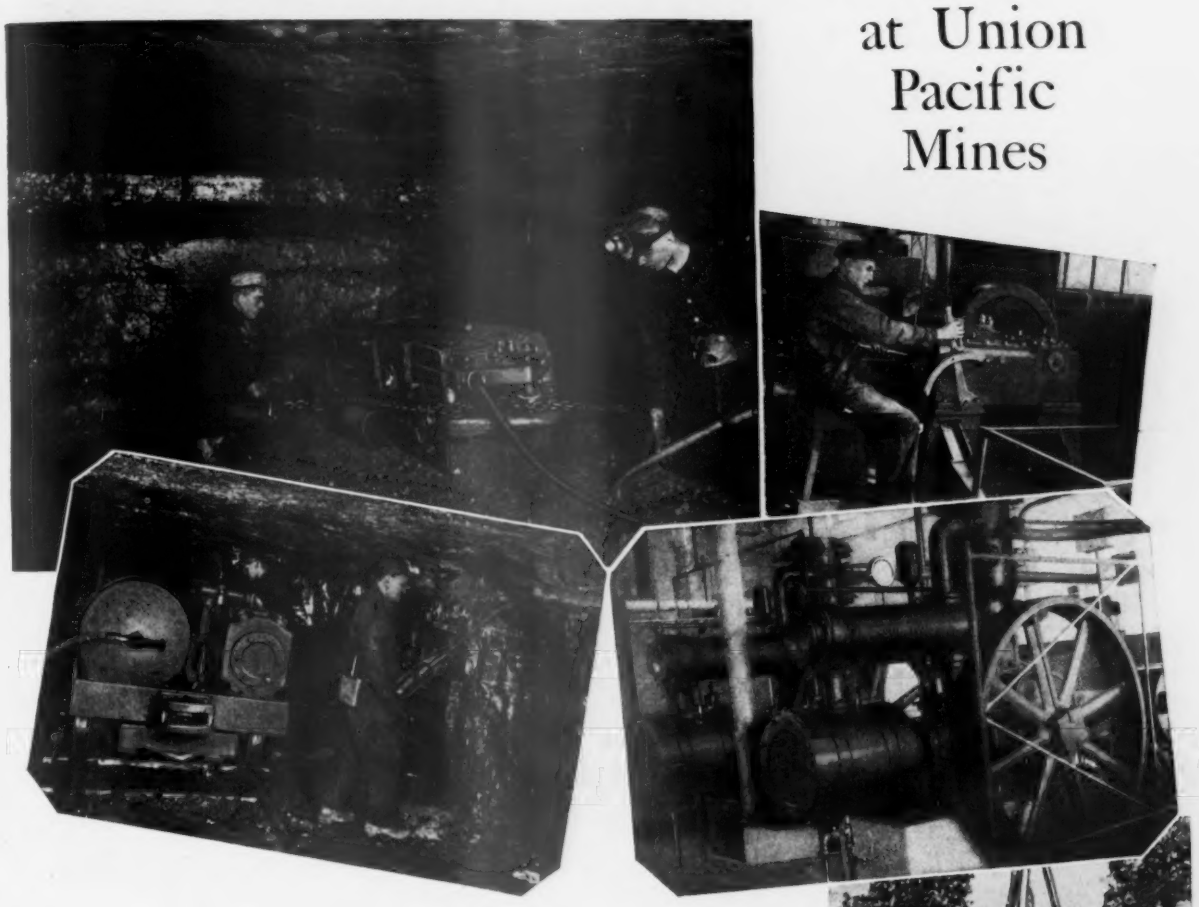
Write for bulletins describing these or other kinds of equipment.

VULCAN IRON WORKS
WILKES-BARRE, PENNA.

MINING EQUIPMENT

BITUMINOUS COAL MINING EQUIPMENT

Sullivan Service is 28 years old at Union Pacific Mines



IN 5 WAYS: In cutting coal, in rock drilling, in the blacksmith shop, in pumping water, and in coal land exploration, Union Pacific's program of production and development employs Sullivan service.

(1) For 28 years, since 1902, Union Pacific has depended upon Sullivan Ironclad Coal Cutters, purchasing the newer models as these have been developed. At most points the machines work in 25-foot rooms. In some sections the CE-7's are cutting long faces. More than 30 Sullivan Cutters are owned.

(2) Air for underground rock drilling is furnished by Sullivan Mine Car Air Compressors, direct motor driven. About a dozen of these units are operated.

(3) Coal cutter bits are kept in shape at Union Pacific Mines, by a Sullivan Cutter Bit Sharpener, which rolls all bits to exact shape and uniform gauge.

(4) At Superior, Wyoming, two Sullivan Angle Compound Compressors give dependable service in pumping water from deep wells by means of the Sullivan Air Lift.

(5) In proving up its coal land holdings, the Union Pacific Coal Company has employed Sullivan diamond core drills repeatedly, and has utilized Sullivan core drilling contract service as well.

The economical performance of these routine operations assists Union Pacific in maintaining production and in holding down costs.

(Catalogs will be sent upon request)

Boston · Cleveland · St. Louis · New York · Pittsburgh · Knoxville · Dallas · Denver · Birmingham

SULLIVAN MACHINERY COMPANY
808 WRIGLEY BLDG., CHICAGO

El Paso · Duluth · San Francisco · Salt Lake City · Price, Utah · Spokane · Muskogee · Terre Haute · Edmonton · Drumheller

SULLIVAN TRADE MARK

LONDON · PARIS · KATOWICE · JOHANNESBURG · SYDNEY · TOKYO · SANTIAGO

BITUMINOUS COAL MINING EQUIPMENT

CARDOX ANNOUNCES

A NEW LEASE CONTRACT

No Royalty. A rental rate of $3.00 per cartridge per month. This reduces cost of coal more than a cent per ton. Supply cost is also reduced through larger volume buying. The initial investment---now reduced more than one-half---is advance rental, all of which is returned to the mining company.

The same advantages of reduction in screenings, improved shipping quality of coal, safety and convenience, are now available at less cost, with increased net realization.

CARDOX will pay you in dollars and cents or we will not install it in your mines. We guarantee its success.

The new Model "G" cartridge is light and easy to handle. Send for our literature and let us make surveys of your mines.

SAFETY MINING COMPANY

307 North Michigan Avenue — Chicago, Illinois

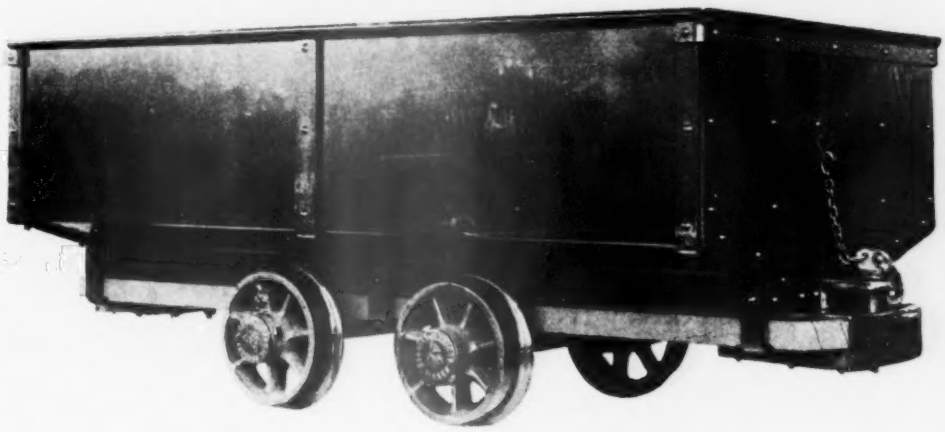
BITUMINOUS COAL MINING EQUIPMENT

The UNION PACIFIC COAL CO.

PURCHASED

WATT CARS

For their No. 8 Mine at Rock Springs, Wyo.
To Round Out Their
MECHANIZATION PROGRAM



SPECIFICATIONS

Capacity	97.79 Cu. Ft. level.
Track Gauge	36 inches.
Wheels	16" diameter, Timken Bearing equipped.
Axles	2¾" diameter. 2½" journal.
Length overall	120 inches.
Width overall	60½ inches.
Height above rail	44½ inches.
Length inside	104 inches.
Width inside	57⅝ inches.
Depth inside	31⅛ inches.

Cars painted a bright yellow as a safety feature.

TIMKEN BEARING EQUIPPED

Cutting haulage costs right down to the bone is lots easier with an adequate supply of modern, maximum capacity mine cars.

Regardless of operating conditions, it costs more to stagger along under the liability represented in cars unsuited to the job than it does to make a reasonable investment in equipment which helps earn profits.

That's why mine operators turn to Watt, an organization which has, since 1863, focused its resources and manufacturing facilities on car designing and building.

Let us help you with your haulage problems.

The WATT CAR & WHEEL COMPANY

BARNESVILLE, OHIO

COAL THAT HERCOAL-F SHOT

• • •

THEY FILL ALL COAL BLASTING NEEDS

Although coal mining conditions vary widely, the nine Hercules permissibles, listed at the right, will satisfactorily meet all coal-blasting requirements in this country.

For instance, tne Lillybrook Coal Company at its Lillybrook and Sullivan mines in West Virginia has adopted Hercoal-F. The improved quality of lump, following the introduction of this permissible, brought about increased market demand for this No. 4 Pocahontas coal.

Hercoal-F is widely used throughout the industry because it combines the lump-producing qualities of black powder with the safety of a permissible—at no greater cost than black powder and with much better fumes.

Check and mail the coupon-list for information concerning Hercoal-F or any of the other permissibles of the Hercules complete series of explosives in which you are interested.

HERCULES POWDER COMPANY

(INCORPORATED)

Wilmington Delaware

ALLENTOWN, PA.			POTTSVILLE, PA.
BIRMINGHAM			ST. LOUIS
BUFFALO	HAZLETON, PA.	NEW YORK CITY	SALT LAKE CITY
CHICAGO	HUNTINGTON, W. VA.	NORRISTOWN, PA.	SAN FRANCISCO
DENVER	JOPLIN, MO.	PITTSBURG, KAN.	WILKES-BARRE
DULUTH	LOS ANGELES	PITTSBURGH, PA.	WILMINGTON, DEL.

The Permissible For Your Coal Is In This List

☐**HERCOAL-F:** The new type lump producer. A very high cartridge count permissible (about 500)* with black powder action.

☐**HERCOAL-D:** This Hercoal lies between F and C in count (about 450),* and like them is a black powder action, lump producer.

☐**HERCOAL-C:** Another black powder action, lump producing permissible. Lower count (about 400),* and stronger per cartridge than Hercoal-F.

• • •

☐**RED H F-L. F.:** Slow and strong with a cartridge count of about 356.* A lump producer.

☐**RED H D-L. F.:** Slow and strong. Cartridge count around 316.* Another lump producer.

☐**RED H C-L. F.:** Slow and strong. About 276* count and a lump producer.

☐**RED H B-L. F.:** A fast, dense, strong permissible of about 280* count with a smashing action.

• • •

☐**COLLIER C-L. F.:** Fast and strong but with higher count (about 320)* than Red H B-L. F.

☐**HERCOGEL:** Dense and strong. Suitable for wet work. Count about 190.*

***NOTE: Cartridge counts refer to the number of 1¼" by 8" cartridges in 100 lbs. of explosives.**

• • •

HERCULES POWDER COMPANY
(Incorporated)
934 King Street, Wilmington, Delaware

Gentlemen: Please send me pamphlets describing the Permissible explosives checked.

Name.....

Company.....

Street.....

P. O......

B-4

THE KOPPERS RHEOLAVEUR COMPANY

AN organization completely equipped with engineering personnel and experience to accept full responsibility for the design, construction and successful operation of coal cleaning plants of any size or capacity to meet individual requirements.

Koppers-Rheo engineers are always ready to cooperate with you.

Koppers Rheolaveur Company
1150 Koppers Bldg., Pittsburgh, Pa.

A Koppers Rheolaveur Coal Cleaning Plant will enable you:

1. To satisfactorily meet the precise specifications of the individual buyer.

2. To obtain increased yield of marketable coal with a greater proportion of larger sizes,—a higher realization in dollars per ton.

3. To obtain low investment in preparation plant and low operating costs consistent with high washing efficiency and substantial, low-maintenance cost structure and equipment.

4. To centralize the responsibility for satisfactory and dependable plant operation with one organization.

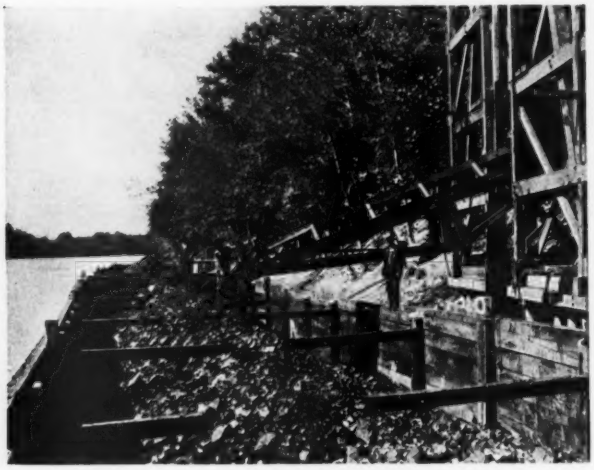
SALES OFFICES
120 Broadway
New York City, N. Y.
First National Bank Bldg.
Huntington, W. Va.
American Traders Bank Bldg.
Birmingham, Ala.
SALES OFFICE and LABORATORY
Coal Exchange Building
Wilkes-Barre, Pa.

Quality Equipment

For 50 years

BELT CONVEYOR
CARRYING COAL FROM TIPPLE TO BARGES

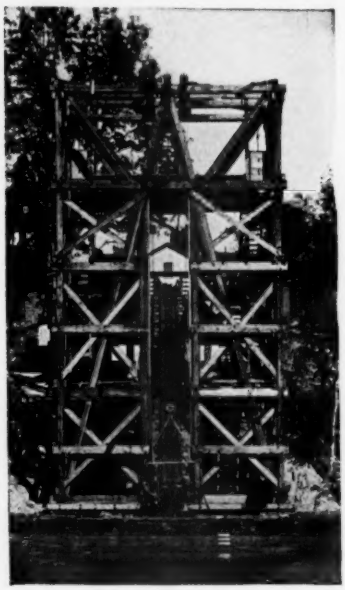
Whether you need a new tipple or just a modernization of the plant you have, it will cost you nothing to consult us regarding your needs.



LOADING BARGES

Often a tipple can be replanned to meet modernized needs at an economical cost.

Webster Engineers
know how to accomplish the maximum of tipple modernization with a minimum of expenditure on the part of the operator.
Their unbiased counsel is offered the operator and when desired will be given after an analysis of the conditions at the property.



FRONT VIEW
OF LOADING BOOM

A complete line of Tipple Equipment including:

Shaker Screens
Picking Tables
Loading Booms
Bucket Elevators
Belt Conveyors
Car Retarders
Car Pullers
Chain, Sprockets, Gears, etc.

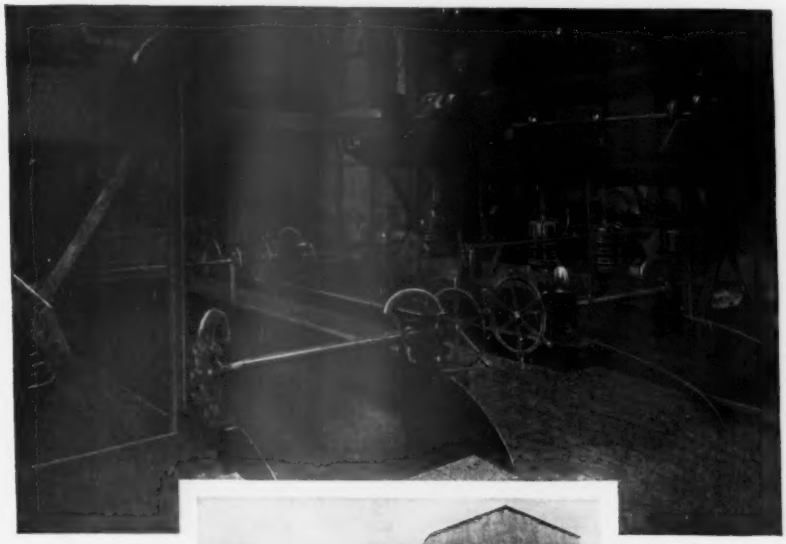
The WEBSTER & WELLER MFG. COMPANIES

1856 N. Kostner Ave. **Chicago, Ill.**

Five plants in U. S. A. and Canada. ***Offices in the principal cities***

BITUMINOUS COAL MINING EQUIPMENT

First one successful plant —now a repeat



This tipple of the Sherwood-Templeton Coal Co., Linton, Indiana including a two-unit installation of the Link-Belt

Simon-Carves Coal Cleaning System was designed, erected, and completely equipped by Link-Belt Company.

INTRODUCED to the American Coal Mining Industry hardly more than two years ago, the Link-Belt Simon-Carves Coal Cleaning System has already reached the "repeat order" stage.

The Central Indiana Coal Co. at Linton, had an opportunity without equal for testing the efficiency of their Link-Belt Simon-Carves installation.

With impurities reaching 30 to 35%, theirs was a most formidable cleaning problem. But the Simon-Carves equipment handled it so successfully the same ownership ordered the Link-Belt Simon-Carves System and complete Link-Belt equipped tipple for their Sherwood-Templeton Coal Co. strip mine shown above.

In addition to this 2-unit Link-Belt Simon-Carves installation with a capacity of 100 tons per hour each, handling all the output 4" and under, the tipple designing, erecting and equipping was a complete Link-Belt job.

Compactness, simplicity, low capital outlay and operating cost, positive attainment of results—the mining industry is justified in the greater interest they are constantly expressing in the Link-Belt Simon-Carves System.

LINK-BELT COMPANY 3985

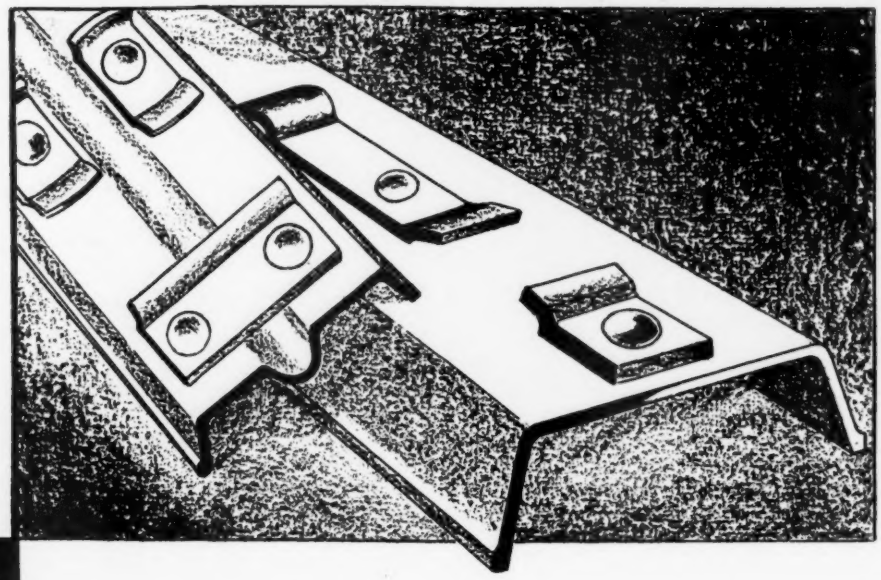
Leading Manufacturers of Materials Handling and Power Transmission Machinery and Chains

CHICAGO 300 W. Pershing Road

LINK-BELT

Simon-Carves Coal Washeries

CARNEGIE COPPER STEEL MINE TIES



COPPER *Resists* RUST

RUST is the natural enemy of steel, and in mines where floors are damp this ruthless destroyer is given free play to work its havoc. Copper, however, resists rust and when added to steel greatly retards corrosion. A prolonged period of service is thus assured from Carnegie Copper Steel Mine Ties.

A number of styles, designed for various conditions, are available. Single or double locking clips are furnished, as you may prefer, and these are riveted to the tie. To firmly secure the rail true to gauge, merely hit the clip with any convenient tool. No special fittings are needed. The tie is complete in one piece, ready to lay. In low seams of coal the shallow depth of these ties saves several inches of headroom and eliminates the necessity of sinking the ties. The broad foot, together with the wide bearing surface, tend to prevent the tie from sinking into soft bottom.

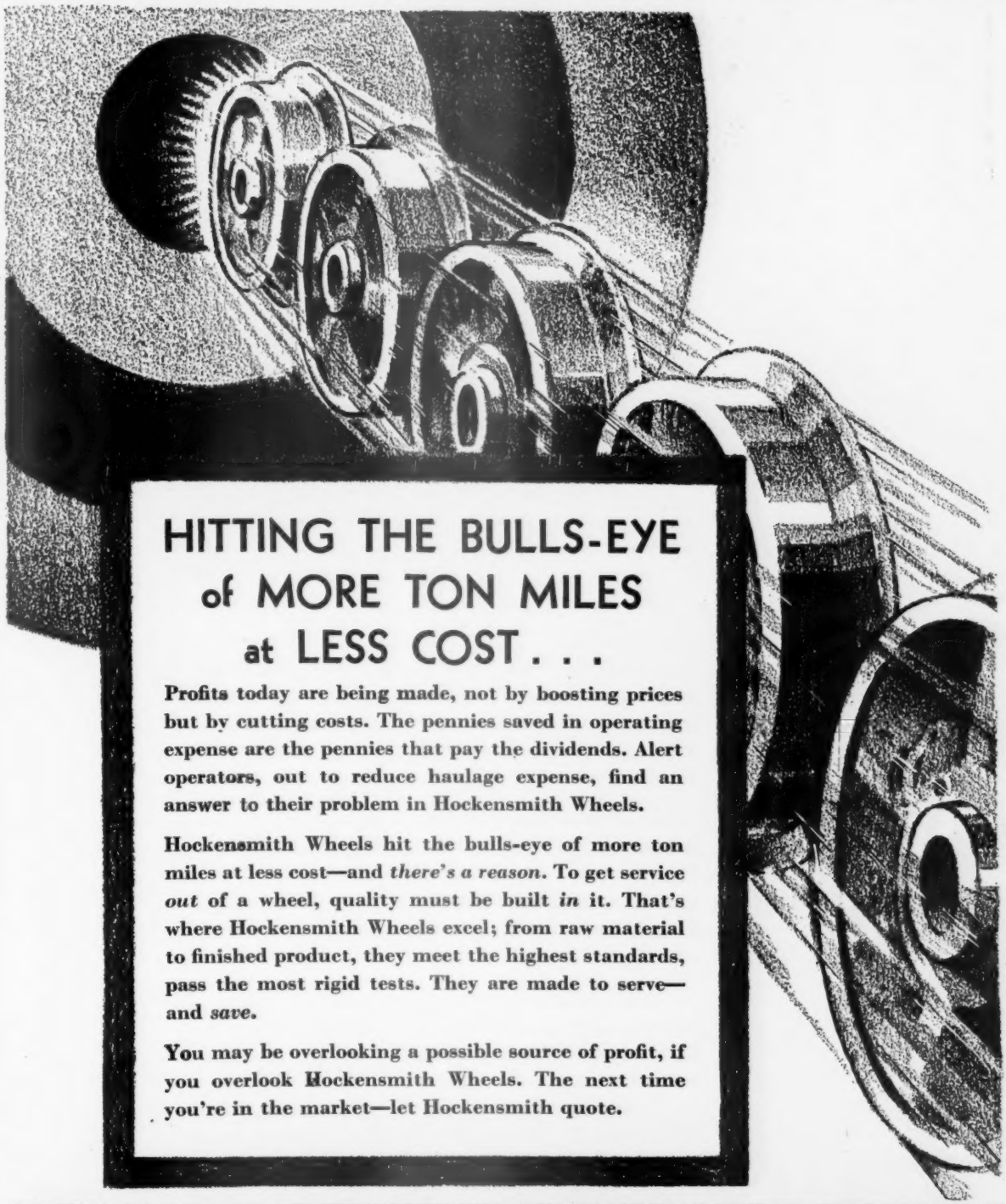
Profitable production demands modern equipment, not only in the cutting of coal, but in its transportation as well. The operator who adds Carnegie Copper Steel Mine Ties to his equipment can check his trackage as one item efficiently and economically cared for.

Catalogue on request.

44

CARNEGIE STEEL COMPANY - Pittsburgh, Pa.

Subsidiary of United States Steel Corporation



HITTING THE BULLS-EYE of MORE TON MILES at LESS COST . . .

Profits today are being made, not by boosting prices but by cutting costs. The pennies saved in operating expense are the pennies that pay the dividends. Alert operators, out to reduce haulage expense, find an answer to their problem in Hockensmith Wheels.

Hockensmith Wheels hit the bulls-eye of more ton miles at less cost—and *there's a reason*. To get service *out* of a wheel, quality must be built *in* it. That's where Hockensmith Wheels excel; from raw material to finished product, they meet the highest standards, pass the most rigid tests. They are made to serve—and *save*.

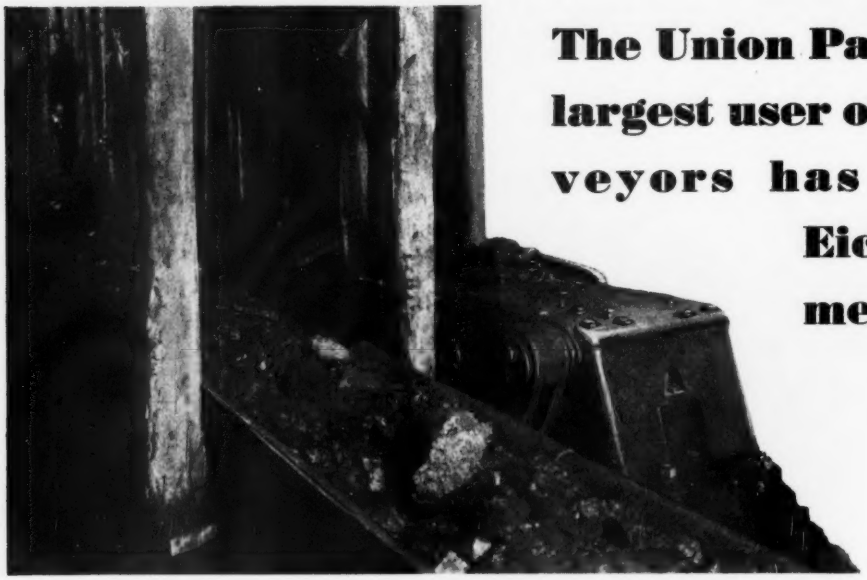
You may be overlooking a possible source of profit, if you overlook Hockensmith Wheels. The next time you're in the market—let Hockensmith quote.

HOCKENSMITH
WHEEL & MINE CAR CO.

Penn, Pa. Long Distance Phone, Jeannette 700

SALES REPRESENTATIVES

Huntington, W. Va.—Huntington Supply & Equipment Co. **Knoxville, Tenn.—Webster & Co.**
Clarksburg, W. Va.—Mr. Norman Strugnell **Chicago, Ill.—W. W. Baker, 140 So. Dearborn St.**



The Union Pacific Coal Co., largest user of Shaker Conveyors has been using Eickhoff Equipment for 4 years

Continuous Reliable Performance

- A softer Kick reducing strain on motor and trough connections.
- A positive Connection of the driving lever which is independent of keys or bolts.
- A Reinforced Casing and Bottom Plate.
- A *Universally linked* Drive Rod eliminating the leverage caused by rigid rods as formerly used.
- A Stronger and Yet lighter trough (three sizes—120, 200, 230 lbs.)
- A New Ball Frame that will outlive any design of Roller Cradle, protect your trough from any kind of rolling or sliding friction as caused by rollers and will keep troughs automatically aligned.
- A Guide Frame that will make your drive trough run smooth and steady.
- A LOWER PRICE.

Low Purchase Cost
Low Maintenance
Low Installation Cost

Applicable with or without Rock Springs Loader

A range of 4 different sizes of driving gears, *all totally enclosed* and *internally lubricated*, 5, 8, 15, 25 H.P., specially designed and adapted in *size and capacity* to Chamber Work, Pillar Robbing and Longwall for both Bituminous and Anthracite Mines.

Buy the Shaker Gear of which over 4,000 are in continuous service.

Buy Eickhoff Ball Frame troughs of which over 1,000,000 ft. have been installed and have made all the difference in Shaker Work.

Eickhoff
BROTHERS

BALL FRAME SHAKER CONVEYOR

116 ADAMS AVENUE SCRANTON, PA.

A Safer, Easier-to-Handle Electric Blasting Cap

Here is the safest and most convenient method of handling and transporting blasting caps. The spool, with the wire wrapped around it, shields and cushions the cap from external forces. Added protection is provided by inserting the spool in a heavy paper tube.

Note position of blasting cap inside paper spool, completely surrounded by coiled wire.

The Union Pacific Coal Company, Rock Springs, Wyo., uses Western ProtectO-Spool Electric Blasting Caps in the *Insulated Package* in their mines at Rock Springs, Winton, Superior, Reliance, Hanna and Cumberland, Wyo.

The Western ProtectO-Spool Electric Blasting Cap in the INSULATED PACKAGE offers a genuine improvement in the handling of electric exploders. It is safer than looped or folded wire exploders and more convenient to handle. It also facilitates priming by reducing the possibility of kinked and tangled wires. The copper shell of the Electric Blasting Cap is INSIDE a heavy paper spool, with the wires wound around the spool. Further protection is afforded by placing the entire spool assembly in a heavy paper tube. The photographs above show how Western ProtectO-Spool Caps provide maximum safety under all conditions.

No Tangled Wires

Shot-firers carrying their shift or night's supply of ProtectO-Spool Caps are not troubled with tangled wires when reaching into their bags or containers, as the tubes can be easily taken out one at a time. With folded wire caps there is always the possibility that several will hang together—the extra cap or caps drop under foot unnoticed in the mine, to be stepped upon later by man or mule.

With ProtectO-Spools this possibility is further reduced by their orderly arrangement in the container which makes it possible to take from the magazine the exact number of caps desired. And after the work is finished, the number used per shift can be quickly accounted for.

Outside Ends Are Shorted

The outside ends of the wires are "shorted" by twisting them together. This prevents loose ends from dangling into contact with a steel rail or coal that is charged with static electricity and eliminates the danger of a premature explosion of the cap.

A Safer Priming Method

The ProtectO-Spool method of priming a hole is safe and convenient. The usual method is to withdraw the cap from the tube and uncoil about two feet of wire from the spool. The cap is inserted in the primer and the remainder of the wire is unspooled while pushing the primer into the hole with the tamping stick. This prevents contact between the ends of the wire and anything that is grounded or charged with static electricity.

Every operator who is interested in providing maximum safety will be interested in Western ProtectO-Spool Blasting Caps. Your inquiry will bring complete details promptly.

Western's line of Blasting Caps includes ProtectO-Spool Electric Blasting Caps, ProtectO-Spool Electric Blasting Caps in the INSULATED PACKAGE, Looped-wire Electric Blasting Caps, and Regular (fuse) Blasting Caps (waterproofed) No. 6 and No. 8 strengths. Prices on request.

WESTERN CARTRIDGE COMPANY

5000 Hunter Avenue — EAST ALTON, ILL.

Western

ProtectO-Spool Electric Blasting Caps

Get these advantages!

BETTER PREPARATION

REMOVES SLACK

HIGHER PRICES FOR COAL

LOW COST PER TON

SPEEDS UP PRODUCTION

THE remarkable sorting action of the Hum-mer—

The small area of screening surface required—

And the immense tonnages handled, have prompted coal operators everywhere to install Hum-mer Electric Screens.

Coal for any purpose can be screened more profitably with Hum-mers than with any other type of screen.

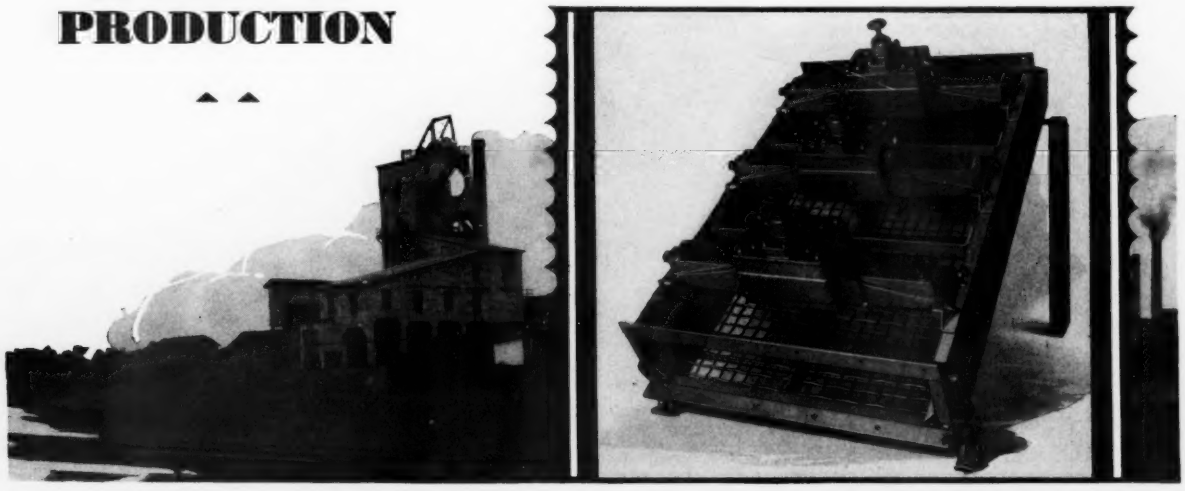
The Hum-mer process of coal preparation combined with efficient coal-cleaning equipment, will enable you to produce far cleaner coal, and at a very low cost per ton.

Let us show you the profitable results other operators are getting and also what the Hum-mer would do for you!

Send for the book, "Screening for Profit"

The* W. S. TYLER COMPANY, *Cleveland, Ohio

***Manufacturers of* Woven Wire Screens and Screening Equipment**



HUM-MER *Electric* SCREEN

Photograph—Courtesy
Ingersoll-Rand Company

More Air for the Drills to Boost the Tonnage

THE drills at the working face must have an accessible and reliable compressed air supply. Efficient mining demands that the compressor unit be moved from one working face to another with the least effort and delay.

The portable mine-type air compressor shown above is designed to fill the usual exacting requirements. Also, it introduces many new features which make for safety, portability, and simplicity in operation. Equipped with Westinghouse Permissible Type Direct-Current Motor and Control, this compressor has been approved by the Bureau of Mines as permissible for use in gaseous mines.

Some of its features are:

All parts of the control are encased in a heavy cover for safety. These parts are easily accessible by removing the one nut which holds the cover top in place.

A motor of special design reduces vibration when the compressor unit is running unloaded.

Air-powered cable reel.

Air motor to propel the compressor from place to place.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

T 30279

Your Best Buy for Cleaner Coal at Less Cost

THE angle of ascension is the lowest we know of. This means that the coal won't roll back as it is being conveyed to the car. The flights are made of one-inch square tubing and are easily replaceable. The wheels are roller bearing. A turn of the convenient hand-wheel lowers or raises the discharge end to accommodate the pit car. You can put your mine on a mechanical basis and yet use the intelligence of human loaders, increasing tonnage and at the same time getting cleaner coal.The low cost of this sturdy "Coalgetter" is a big factor. Get complete information.

REPRESENTATIVES

H. J. Hersey,
315 Dooley Block
Salt Lake City, Utah

The O. H. Davidson
Equip. Co.
130 W. 14th Ave.
Denver, Colo.

E. H. Gibbs
3505 Wayne Ave.
Bronx, N.Y. C.

R. R. Schubert
531 Sewickley St.
Greensburg, Pa.

W. T. Thurmond
628 4th St.
Huntington, W. Va.

MANCHA'S "COALGETTER"

MANCHA STORAGE BATTERY LOCOMOTIVE CO.

1909 So. Kingshighway · *Manufacturers of Mancha's Electric Mule* · St. Louis, Mo.

Please send me complete information on Mancha's "Coalgetter".

Our coal is..... inches thick.

Track gauge is..... inches.

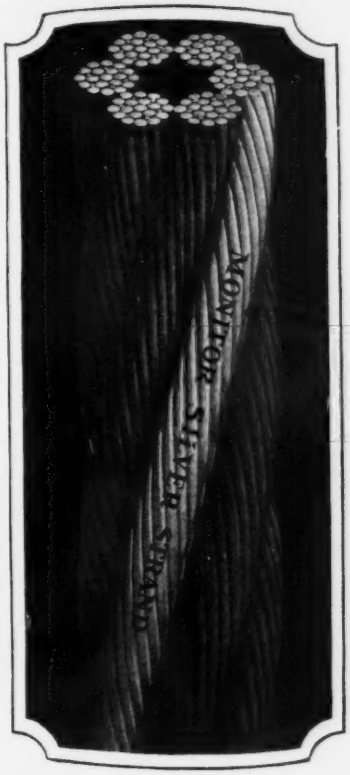
Name.....

Firm Name.....

Address.....

City..... State.....

The Measure of Wire Rope Quality is the SERVICE it has Rendered



Which wire rope to use on your equipment—which brand will give the longest and most economical service—may be best determined by past records of performance established under similar operating conditions. This and the reputation of the maker are of paramount importance.

For over half a century American Wire Rope, made exclusively by the American Steel & Wire Company, has demonstrated its superiority—proved beyond question that its tough, flexible and abrasion-resistant nature is the best insurance against breakdowns and costly delays.

Regardless of your particular problem, you will find an American Wire Rope exactly adapted to its economical solution. Consult our nearest branch office or distributor to get the right rope for your purpose.

AMERICAN STEEL & WIRE COMPANY WIRE ROPE

AMERICAN STEEL & WIRE COMPANY

SUBSIDIARY UNITED STATES STEEL CORPORATION

208 S. La Salle Street, Chicago — 30 Church Street, New York

Other Sales Offices: Atlanta, Baltimore, Birmingham, Boston, Buffalo, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Memphis, Milwaukee, Minneapolis-St. Paul, Oklahoma City, Philadelphia, Pittsburgh, Salt Lake City, St. Louis, Wilkes-Barre, Worcester

U. S. Steel Products Co.: San Francisco, Los Angeles, Portland, Seattle, Honolulu

Export Distributors: United States Steel Products Co., 30 Church St., New York City

Mine Cars At Mine No. 8 Union Pacific Coal Company

Characteristic of the advanced methods of production employed by the Union Pacific Coal Company is the extensive use of Timken Bearing Equipped mine cars.

The photograph shows a train of Timken-equipped cars at Mine No. 8, Rock Springs, Wyoming—just a few of the total number in service there. These cars were built by the Watt Car & Wheel Company, Barnesville, Ohio.

Everywhere throughout the country, mine operators have turned to Timken-equipped mine cars, electric locomotives, loaders, conveyors, motors, pumps, blowers and other equipment for the economy, dependability and endurance which the exclusive combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel makes possible.

Through this combination Timken Bearings are not only anti-friction—but anti-wear, anti-radial-thrust loads—in fact anti everything that is antagonistic to bearing life and efficiency.

With mine cars on Timkens, longer loaded trains can be hauled per locomotive per trip. Cars are more easily handled by hand in rooms and entries. Lubrication is simple, certain and economical. Cars can be kept in continuous service with very little attention. And car maintenance costs are cut to the bone.

THE TIMKEN ROLLER BEARING COMPANY
C A N T O N , O H I O

The
MINING CONGRESS JOURNAL

**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 16 FEBRUARY, 1930 No. 2

Editorials

Stabilization and Conservation

NO merchant can afford to stock up with goods with the possibility that his competitor, through a cut in freight rates, could obtain competing goods at a lower cost.

The Interstate Commerce Commission was created by Congress over the opposition of practically all of the railroads. The right of Congress to enact laws controlling transportation rested upon the fact that rail roads are common carriers and for their development require the right of eminent domain and were necessarily semi-public corporations.

The Commission was not given the right to fix rates, but it was given the power to declare that a particular rate was unreasonable, and, therefore, by the process of elimination, a rate not declared to be unreasonable was assumed to be reasonable.

One of the principal public purposes served by the Interstate Commerce Commission is the prevention of widely fluctuating rates of transportation. The merchant in any particular part of the United States could at all times ascertain the cost of transportation service and, except during times of freight wars, had the assurance that his competitor's prices would include the same transportation cost as those attached to his stock of merchandise.

This stabilization of cost justified the merchant purchasing goods for future sale, which, under different circumstances, he would not be justified in contracting for. In other words, business conditions were stabilized by a more or less uniform and stable transportation rate.

In the marvelous commercial growth of the United States, a stabilized freight rate under the direction of the Interstate Commerce Commission has been a very important factor.

This illustration is given to show the importance of a stabilization of mineral production to take the place of the present wasteful over-production now so prevalent in this country. Few people realize how vastly important it is to industrial and manufacturing enterprises that the flow of raw material should be uniform and constant, and always in sufficient amount to meet the demands of commerce.

Production and Taxes

THE conditions of the mining industry are entirely different from any other because of the wasting character of that industry. Minerals once taken from the ground can never be replaced. If by wasteful over-production we exhaust our mineral supply in the next fifteen or twenty years, we shall find that thereafter our whole business structure would collapse because of the lack of minerals which under proper conservation would have been sufficient to last us a much longer period.

In mining a certain area of mineralized ground, that part of the ore which is not beneficiated will be lost to future use by taking out the higher grade ore and confusing the lower grade ores with other waste material to a point where a further recovery would be prohibitive because of the increased cost. If applied properly, these arguments seem to be conclusive, but there is another phase of equal importance from the standpoint of Government.

The continuance of production is necessary to the maintenance of the nation's tax basis and contrary to the present conception, it is not the loss of the tax upon the mineral production which in itself is very considerable, but the loss of profit upon the fabrication and refabrication of the mineral products into the various shapes required for industrial use.

The pound of pig iron costing ten cents, when manufactured into hair springs is worth $300,000 or $400,000. The difference being a profit subject to the Federal Income Tax law. It is time that the nation awakened to the importance of conservation of its mineral supply, and to the end that we may bring about the highest use and the least possible waste.

Business and the United States Senate

VERY many are the criticisms which have been levelled against the United States Senate. First, because of its failure to enact a tariff law during its special session; and, second, because of its committees of investigation. Many business men insist that that element within the Senate which was able to prevent the enactment of a tariff law is responsible for the creation of unrest in the business world which brought about the wholesale depreciation of stock prices and the almost panic which resulted from rapid liquidation. There can be little question but that business is always solicitous whenever a change in tariff rates is impending. The revision of our tariff laws is generally agreed upon as being necessary at this time. The business interests of the nation were confident that tariff revision was in the hands of its friends and that there was no doubt that a proper revision would be accomplished. Industries would not have suffered had the changes been sought in an orderly way and reasonable efforts made to bring about an early conclusion. When, for various reasons, action on the tariff was delayed, it caused a lack of confidence both in the Senate itself because of its failure to proceed in an orderly way and of the future of business because of the possible danger to tariff structures upon which prices are largely predicated. We regret that a proper tariff bill could not have been completed in order that the regular session might devote itself to other matters of importance.

Advance and Give the Countersign

SENATOR WATSON is a brilliant man, an able Senator, and is accredited with a considerable amount of political acumen. He has been seriously thought of by his party as "presidential timber."

Mr. Watson comes from a great state—a state that has been an important factor in the bituminous coal industry until destructive wage scales forced the industry in that state into a very serious position. Bituminous coal has been the football of present-day politics, which is an unfortunate situation for both coal and politics.

The Watson-labor union coal bill is with us again—reintroduced (how many times?) in the Senate. Is there any new necessity for the proposed legislation? Where does the industry stand at the beginning of a new year and a new Congress?

This number is devoted to the subject of bituminous coal. In its pages are found a number of illuminating articles on the state of the industry, its present and its future. One of them, by Mr. Charles P. White, of the Coal Division of the United States Bureau of Mines, says that we produced 528,000,000 tons in 1929; that the by-product coal industry is on the up-grade. The National Coal Association, through Mr. Gandy, reports the industry as emerging from its troubles. Representatives of the various coal-producing districts—Illinois, Indiana, Pennsylvania, West Virginia, Alabama, and Kentucky—all report improvement. Dr. Thomas S. Baker, of the Carnegie Institute of Technology, points the way to the future, and Mr. C. J. Ramsburg, of the Koppers Company, not only points the way but holds the door wide open.

The trend in bituminous coal is clearly defined. Illinois produced 48 percent of her tonnage mechanically during the last month of the year; in one state 63 mines produced in 1929 the total tonnage of 147 mines in 1928; by-product coke ovens increased their capacity. Surely bituminous coal is on the march.

While it is a matter of common knowledge that the industry still has an over-production capacity, the status at the opening of 1930 is encouraging. The industry is busily and constructively engaged with its problems.

Legislation such as Mr. Watson, by request, proposes does not advance the cause of the labor union and merely obstructs progress.

Fair Trade Practice Agreements

FOR some few years past there has been a growing development of what is known as fair trade practice agreements under the direction of, and in cooperation with, the Federal Trade Commission. The act creating the Federal Trade Commission declared "that unfair methods of competition in commerce are hereby declared unlawful," and it was further enacted that "the commission is hereby empowered and directed to prevent persons, partnerships, or corporations, except banks, and common carriers subject to the acts to regulate commerce, from using unfair methods of competition in commerce."

During recent years the Federal Trade Commission has exhibited a keen desire to assist business and to cooperate with it along such lines as would not be inimical to the general public interest.

In this behalf it has, at the request of individuals, called conferences of certain lines of business and been instrumental in securing an agreement among the members thereof, as to such practices as meet the approval of the Federal Trade Commission, which would remove unfair competition by mutual agreement, thus removing from the obligation of the Federal Trade Commission the necessity for it to prevent unfair methods of competition.

It has been supposed that a practice meeting the approval of one arm of the Federal Government would be immune from investigation by another arm of the same Government. It is not, therefore, surprising that a strong protest should arise when it is found that the Department of Justice is investigating the acts of a fair trade practice agreement which has been developed and approved by the Federal Trade Commission.

Mr. K. R. Kingsbury, president of the Standard Oil Company of California, has expressed himself as follows:

"The situation presents the disconcerting aspect of one department of the Government challenging the legality of an action taken at the request of another department.

"It appears that the investigation will relate to the adoption of a code of marketing ethics by the oil industry. The national code of market ethics was framed after two years of public effort on the part of the American petroleum industry for the purpose of securing uniformly fair practices in the oil industry and to promote the principles of conservation in business in which the Federal Administration has shown so much interest.

"The proposed code was submitted by the American Petroleum Institute to the Federal Trade Commission and brought to the attention of the Department of Justice. Later the Federal Trade Commission approved the code, after it had made certain amendments thereto, and the code was then signed by oil companies throughout the United States at the request of the Federal Trade Commission.

"It is surprising that the legality of the code should now be subjected to investigation and attack by the Department of Justice.

"It would seem that the oil industry was justified in assuming that a code of marketing practices which was fostered and specifically approved by the Federal Trade Commission and signed at the commission's request would not thereafter be attacked by the Department of Justice. In effect, it is an attack upon a movement in the oil industry directly in line with the efforts of the administration as recently indicated by the conferences called by the President for the stabilization of business and the promotion of economy in business practices.

"It is a peculiarly unfortunate time for the Department of Justice to attack those who are endeavoring to cooperate with the Government in promoting its policies of conservation not only in marketing but in the production of crude oil, and whose efforts are already attended with enough difficulty. Such an attack will obviously encourage those who for selfish reasons are opposing these policies."

The authority of the Federal Trade Commission to prevent unfair methods of competition is directly and effectively challenged. By this process any act which can be suspected of being wrong is, in effect, absolutely wrong. An agreement by the owners of an oil pool not to recklessly waste that part of the nation's gasoline supply, while righteous in itself and approved by the Federal Trade Commission, is illegal under the construction placed upon the law by public prosecuters whose opinion has the effect of law, because these men can not afford to defend against a Government prosecution.

Is it not time that the "twilight zone" should be eliminated by legislative act? If we are to have a government of men, then give industry a chance to present its case directly to and receive a final decision from the men in control. If we are to have a government of law, then let the law be so clearly stated that its construction does not depend upon the conclusion of the fifth man on the bench of the Supreme Court after years of litigation.

Silver and Surplus Manufactures

MORE than one-half of the world's population are users of silver as a medium of exchange and value. India has long been known as the sinkhole of silver. Surplus crops in India lead with certainty to large purchases of silver, and the surplus wealth of India is hoarded either in taels, ornaments, or in bullion.

A great part of this silver was purchased at a price considerably above $1 per ounce. Before the great war the monetary stock of silver in India was $239,959,000, and it is estimated that the people of India are hoarding silver to the extent of five billion ounces. During the war India willingly paid the United States $1 per ounce for 208,000,000 ounces of silver, taken from the Treasury of the United States. This sale by our Government was made under the stipulation which required the replacement in the Treasury of a similar amount of silver purchased from the silver producers of the United States at the price which was received from Great Britain. For a short time these purchases resulted in stimulating the silver industry of the United States.

After the war, the sale of silver to Poland and the apparent promises that silver would gradually be brought back into use as a subsidiary coinage in gold-standard countries advanced the price of silver to a point where its production would not become a burden to other minerals with which it is associated in the complex ores of the West.

The growing use of credit money based on the gold standard has taken from silver much of the demand for its use as subsidiary coinage; and the net result of all these influences has been to depress the price of silver to the lowest point in history.

It is not the function of Government to legislate prosperity into any line of business. It is the duty of Government to create those conditions in which every citizen shall have ample opportunity to make the best of prevailing economic conditions. The above statement of principle has not controlled the United States in the matter of farm legislation, and there have been efforts on the part of specific industries to secure from the Government special assistance.

If silver is the main form of India's wealth; if the industry's over-production of silver tends to reduce abnormally the amount of that wealth and the purchasing power of that nation, then it seems a matter of public concern. The lowering of purchasing power in those foreign markets to which we must send at least 10 percent surplus manufactured products of this country in order to maintain industrial prosperity at home is a matter of general concern.

It is not that the Government should directly undertake to meet this situation, but the Government which says to the silver producers of this country, "You shall not combine to limit production in accordance with probable market demands," might well abate this rule under present conditions.

A retrospect of our current industrial conditions reveals the fact that when we are able to send abroad but 5 percent of our surplus production, the United States suffers great business depression. When we export 7½ percent of our surplus production, times are fairly good; and when we export 10 percent, every man desiring employment has a job, every wheel of industry is in operation, every savings bank is increasing its savings deposits, and general prosperity prevails throughout the land.

Is it not, then, a matter of supreme concern when the over-production of silver on the Western Hemisphere results in the destruction of a great market for our surplus goods?

A Silver Tariff

THE attack upon the American Mining Congress made by Senator Pittman on the floor of the U. S. Senate seems to have been accepted as proof that this organization is fighting the proposal that a tariff shall be placed upon the importations of silver into the United States.

We desire to again correct that impression. It is the function of the American Mining Congress to assist, to the extent of its ability, any proposal which has received the endorsement of the majority of those engaged in the industry, but it is not its function to oppose efforts made by a minority in behalf of some reform which that minority deems to be of benefit.

The proponents of this tariff are themselves responsible for the belief that the Mining Congress is fighting their proposal.

This belief is evidenced by a number of telegrams and letters endorsing such supposed opposition. Among them, we reproduce a Denver telegram from that veteran silver advocate, Ex-Governor and Ex-United States Senator Charles S. Thomas, of Colorado:

"I unqualifiedly endorse your opposition to the proposed duty on silver. I have been an advocate and student of bimetallism for nearly sixty years and am quite familiar with the subject. A duty could not aid and might injure the metal whose value is almost wholly dependent upon its use as money. Sixty-five percent of American output is the by-product of other metal mining. Being an exporter of silver no domestic duty can aid it. Previous efforts to impose a duty have properly failed. The one possible aid for silver is to increase its monetary use. London fixes its market price for the world and will continue to do so under all conditions short of its remonetization."

An International Silver Conference

AT this time the price of silver is the lowest in the history of the world. The depression in silver prices puts a handicap upon the production of gold, silver, lead, copper, and various other minerals because these minerals are associated with gold in the ores in which they are contained.

The various world-wide influences which have made for the present depression in silver prices may lead to a very much greater depression. The great bulk of the world's silver is produced in the Western Hemisphere. Canada, Mexico, Chile, Bolivia, Peru, and the United States produce four-fifths of the silver of the world. The silver producers of these countries have no association with each other. These industries in each of these countries are blindly fighting against extinction.

As such, the silver producer is not entitled to special governmental aid, but from the standpoint of distress which the wrecking of this industry will bring upon the people of the world, it is a matter of vast importance.

The visible wealth of Oriental countries is very largely composed of silver in one form or another. It is estimated that India and China possess of this hoarded silver approximately 5,000,000,000 ounces.

A drop in the price from 60 cents to 40 cents means a reduction of one-third of the visible wealth of those countries. The world production of silver for any of the current given years is approximately but 2 percent

of the total world production to date, and yet that 2 percent production, with a total value of approximately $125,000,000, has in a few months depreciated the visible wealth of the Orient $1,000,000,000.

This loss in visible wealth of the countries of the Orient, in whose markets we hope to dispose of at least a part of our surplus production, will greatly hamper our exports and thus depress prices in our home markets.

These figures are startling. They are only approximately accurate, but with all deductions that can be fairly applied, there still remains an enormous public problem, the solution of which calls for the genius of statesmen.

What is to be done about it? The first suggestion would be that those who are directly interested in the business should be called into conference for the purpose of discovering whether or not some remedy may be developed to meet this appalling situation.

Intelligent selfishness is the mainspring of all progress. Who then has a selfish interest to prevent this rape of the wealth of the Orient? All people everywhere have a general interest, either for want of supplies or for want of a market in which supplies may be sold or perhaps because of appeals for aid to Far East relief.

The silver producers have the predominant selfish interests which, intelligently exercised, will render unmeasured service to world prosperity.

No one country can meet the situation. The entire extinction of the silver-mining industry in any one of these countries would not materially affect the general situation. It is necessary that all shall act together to justify any hope of betterment. The healthy operation of every industry is important to general prosperity. Each cog in the wheel must do its part if the machinery of business is to run smoothly. Silver is so closely associated with other metals that it is peculiarly important.

We suggest the importance of a conference of the silver countries of the Western Hemisphere for consideration of some means by which these vastly important business problems centering in the silver-mining industry shall find some means of solution.

The World's Gold Supply

AT a recent hearing before a New York State legislative committee, Prof. Irving Fisher made a statement which is of particular interest. Professor Fisher said: "Unless some form of international credit of gold and its production is put into effect, the trend toward a lack of sufficient gold for the world's economic needs will continue and will reach a crisis attended by insufficient credit and a collapse of commodity prices."

While the gold production of the United States is less than half of pre-war production, the world's production of gold has not materially decreased. During the years which our gold production has been at its lower rate, our nation's gold supply has been greater in proportion to the world supply than ever before, largely brought to us in settlement of trade balances due from foreign countries. A part of this gold which is more than our just share of the world's supply will, sooner or later, drift back to those countries in which a sounder money medium is essential to prosperity.

During these years the uses for money have been vastly increased, but at the same time modern credit devices have multiplied largely the service which gold can render. It is also true that during that period the amount of goods, the value of which must be measured in terms of money, has increased at an enormous ratio. Celerity of movement is an important factor in the service which can be rendered in business transactions, and a dollar which passes through 50 transactions in a day renders 50 times the service that that same dollar would render if used but once. We have always contended that some day gold-mining operations would again be prosperous, but we have not been willing to advocate a collapse of commodity prices in order that the gold industry might be served. It is very evident that low-grade ore bodies mined in pre-war days with only a fair profit can not now be mined profitably with the production costs increased 50 percent. To lower price levels to a point which would make the mining of low-grade gold ores profitable would require a business panic which, in turn, would be followed by suffering and want, lack of employment, and general disorganization of business. And yet the day is surely coming when a road will be found to increase gold production to a relative parity with the gross total of the world wealth which it measures. *The relentless law of supply and demand will not hesitate to crush industry if no other plan is devised to preserve its rule. To the extent that silver is being driven from coinage use, the burden on gold is being increased. An increasing demand and a decreasing production are leading gradually, slowly but surely, to an ocean of financial distress.*

The particular function which gold serves in national affairs makes it the only commodity of which Government operation can be justified. A tax upon all of the people for the maintenance of gold production sufficient to meet the needs of commerce would be infinitesimal as compared with the burden which would be put upon them by a business panic which would so lower price levels as to make gold mining on a pre-war scale possible. He who can devise a scheme which will keep the world's gold supply on a basis commensurate with world requirements will deserve a crown of reward.

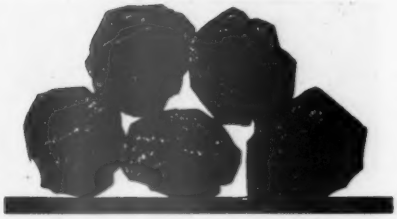
Minority Rule

AN INDUSTRIAL leader calls attention to the fact that 36 states having less than 45 percent of the population of the United States, and paying less than 27 percent of the taxes, hold a whip hand over any constitutional action by Congress.

He goes on to show that 13 states, having little more than 5 percent of the population of the country, and paying only 2 percent of its taxes, can prevent 35 states, having nearly 95 percent of the population of the United States, and paying nearly 98 percent of the Federal taxes, from any similar action.

This really means that a little more than five million people can prevent more than one hundred million people from an active voice in matters of national welfare.

For a so-called representative Government, this gives pause for thought. When we comprehend the enormity of the situation, we realize more than ever before how it is that noisy minorities walk off with victory after victory, while conservative majorities placidly pursue the even tenor of their way, and accomplish but little.



The BITUMINOUS COAL INDUSTRY in 1929

Definite, if gradual, progress marks record of 1929—Decline of bituminous coal stocks an indication—Exports, Lake Shipments and Tidewater trade stir—By-products, Bee-hive, electric utilities, steam railroads, and steel plant consumption increases—Liquidation of excess capacity aids labor and efficiency—Improvement in technique accompanies rapid rate of increase in mechanical loading introduction underground—Trade strives to put its house in order in merchandising improvements and internal ethics

By C. P. WHITE *

A SLIGHT, but definite improvement characterized the bituminous coal industry in 1929. Preliminary estimates of the Bureau of Mines indicate that bituminous coal production for the year amounted to 525,358,000 tons, an increase of 24,613,000 tons or 4.9 percent when compared with the output for the previous year. In fact, with the exception of 1926 when the trade was stimulated by an unusual demand for exports overseas, bituminous coal production was greater than in any year since 1923 and showed a gain of 1.2 percent over the average for the five preceding years.

The increase over 1928 was apparent in almost every month of 1929. Only in March and November did the output fall short of that of the corresponding period of the previous year. In spite of the reaction in security prices the year closed with the bituminous market in a relatively strong position. Production for December is estimated at 46,200,000 tons. This was considerably higher than the output in the same month of either 1928 or 1927.

Of outstanding interest are the indications that Pennsylvania regained first place in soft coal production in 1929 while West Virginia dropped back to second place. According to rough preliminary estimates, which may shortly be revised, the bituminous coal production of Pennsylvania amounted to 142,000,000 tons as compared with 138,000,000 tons for West Virginia. In spite of this, West Virginia produced 5,000,000 tons more coal than in the previous year. Kentucky retained its place as the third largest producing state with an estimated output of 62,000,000 tons, although Illinois pressed close behind with a production amounting to 60,000,000 tons. Production in Ohio increased by over 50 percent in 1929 when compared with the previous year, amounting to 24,000,000 tons as against 15,641,000 tons in 1928. In Indiana production also increased, the total for the year being approximately 17,500,000 tons.

DECLINE IN STOCKS

Among the chief factors contributing to the improved conditions in the industry in 1929 was the liquidation of the heavy reserves accumulated in anticipation of strikes in the Central Competitive Field in 1927, and which had remained at unusually high levels since that time. At the beginning of the year the total quantity of bituminous coal in storage amounted to 41,800,000 tons. During the first half of the year production failed to keep pace with the current rate of consumption and stocks declined steadily. On April 1 the quantity on hand had been reduced to 36,900,000 tons, and an additional 3,800,000 tons was withdrawn from storage during the second quarter of the year. The 33,100,000 tons remaining in the hands of commercial consumers on July 1 was the smallest tonnage reported since the close of the great suspension of 1922.

Between July 1 and October 1, stocks increased slightly, but the 37,500,000 tons in storage at the beginning of the fourth quarter were 3,600,000 tons below the tonnage on hand on October 1, 1928, and were also less than the amount on corresponding dates in 1927 and 1926. How stocks stood at the close of the year will not be known until the Bureau completes the quarterly survey of stocks on which it is now engaged.

EXPORTS AND IMPORTS

Improved conditions also prevailed in the export market in 1929. Preliminary figures show that total exports of bituminous coal for the year amounted to 15,561,873 gross tons as against 14,432,576 tons in 1928, a gain of 1,129,297 tons or nearly 8 percent. This increase was chiefly accounted for by heavier shipments to Canada and Italy. Exports to Canada amounted to 13,074,018 tons of bituminous coal in 1929 as compared with 12,463,358 tons in the preceding year. Shipments to Italy during the same periods showed an increase of 282,008 tons. Smaller increases are also shown in shipments to certain other destinations, notably Newfoundland and Labrador, the British West Indies and Bermudas, Virgin Islands, Panama and Brazil.

Under normal conditions imports of bituminous coal into the United States fluctuate but little from month to month or from year to year. They consist chiefly of coal from Vancouver Island and Alberta received in Washington, Montana, and Idaho, and a small tonnage imported through the Pacific coast ports as ballast in vessels from Australia and Japan. Preliminary figures for 1929 show bituminous imports amounting to 442,160 gross tons as compared with 487,970 tons in the year 1928.

* Chief, Economics Branch, Bureau of Mines.
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Transportation and Labor Conditions

There was a remarkable absence of either transportation or labor disturbances in 1929. The railroads gave as near perfect service as was possible to expect. A few scattered districts were affected by local strikes, but none of these were of major proportions. The remaining union fields continued to operate without interruption under terms of the agreements reached in 1928.

Lake Shipments

The movement of bituminous coal to the Great Lakes increased sharply in 1929 and for the third consecutive year broke all previous records. According to the Ohio Bureau of Coal Statistics, shipments of cargo coal to the lakes amounted to 37,800,000 tons, an increase of 13.3 percent when compared with the 33,323,724 tons in 1928.

This record movement is partly explained by the reduced rail rates to the lower lake ports which have apparently opened new markets for coal moving by way of the lakes to northwestern and middle western destinations. Nearly all districts normally participating in this trade shared in the increase. Ohio took a long step toward regaining some of its lost markets by shipping 3,200,000 tons to the lower lake ports in 1929 as compared with 1,053,032 tons in 1928. The Pocahontas field showed a gain of 1,440,000 tons in shipments to the lakes in 1929. Other significant gains are shown for western Pennsylvania, and the Kanawha, New River, and Kenova-Thacker districts of West Virginia.

Of the tonnage shipped to the lakes in 1929, 84.2 percent was billed for American ports and 15.8 percent for Canadian ports. This is much the same proportion as in 1928 when 83.1 percent was destined for American ports and 16.9 Canadian. A large part of the increase in lake shipments in 1929 went to points at the southern end of Lake Michigan.

Tidewater Trade

The total quantity of bituminous coal dumped at the five ports—New York, Philadelphia, Baltimore, Hampton Roads, and Charleston (S. C.), amounted to 38,050,908 net tons. This is an increase of nearly 10 percent over the previous year and the largest shipments to tidewater destinations since the record year of 1926. Hampton Roads, of course, continued to lead in the tidewater business, handling 22,363,615 tons, or 58.8 percent of total shipments. New York ranked second with shipments of 9,420,928 tons while Baltimore, Philadelphia and Charleston (S. C.), followed in the order named.

Coal destined for New England comprised nearly 38 percent of the shipments from the tidewater ports in 1929, amounting to 14,444,885 tons, an increase of 7.4 percent when compared with 1928. Shipments to New England last year were also greater than in 1926 and 1928 but less than in 1927.

C. P. White

Trend of Consumption

From January 1 to September 30, 1929, the average rate of bituminous coal consumption in the United States, including net withdrawals from stock piles or reserves in transit was 9,493,000 tons a week. In comparison with an average weekly consumption of 9,061,000 tons for the corresponding period of 1928 this is an increase of 4.8 percent. Exports for the first nine months of 1929 averaged 327,000 tons a week and total consumption plus exports showed an increase of 5 percent over the figures for the previous year.

This increase in the rate of home consumption clearly reflects the improved conditions prevailing in most branches of industry throughout the first nine months of last year. An increase over 1928 in the rate of consumption is shown for nearly all the principal groups of consumers throughout the first three quarters of 1929 and, although complete figures are not available for the closing quarter of the year, scattered reports from important consuming groups indicate that the coal trade was little affected by the collapse of stock market prices in late October. It seems altogether likely therefore that the total consumption for the year will be considerably greater than for 1928.

By-product coke.—Probabldy the most striking advance in coal consumption occurred at the by-product coke plants. This important industry moved at unusually high speed throughout most of the year. For the first quarter of 1929, each successive month established a new production record. There was a pause in the upward movement in April, but again in May all records of by-product coke production were broken. Thereafter output declined slightly, but continued at a level well in advance of 1928 through November. In December production fell somewhat short of that for the same month in 1928, but the net result of the year's activity was that more coal was consumed at by-product plants in 1929 than ever before. The total estimated consumption for the year amounted to 77,178,000 tons, an increase of 10 percent when compared with the 70,165,906 tons consumed in 1928.

Electric utilities.—Due in part to the growing demand for electric energy and in part to a decline in the production of electricity by use of water power, caused by abnormally low rainfall in certain sections of the country, the consumption of coal by electric public utilities in 1929 showed a substantial increase over 1928. From January through November, a total of 40,746,000 tons of coal was consumed by the electric utilities. This is an increase of 8.7 percent when compared with the 37,496,000 tons consumed during the same months of 1928. Each month throughout the first 11 months of 1929 showed an appreciable gain in the rate of coal consumption over that for the corresponding month of the previous year.

Steam railroads.—Consumption of coal by Class I steam railroads also increased in 1929. During the first 11 months of the year a total of 103,276,000 tons of coal was used by locomotives of Class I railways in road-train and yard-switching service. In comparison with the 101,968,000 tons used during the same period last year this is an increase of 1,308,000 tons. The largest increase was shown by the roads operated in the central eastern region, but other gains occurred in the Great Lakes, Pocahontas, northwestern and southwestern regions. The only regions showing decreased consumption by the railroads were New England, central western and southern.

Steel plants.—Complete figures on the consumption of coal by the iron and steel industry are not available, but reports have been received by the Bureau of Mines covering the months of February and March, May and June, and August and September. Estimates based on the output of steel ingots for the intervening months indicate that the consumption of coal by steel plants during the first three quarters of 1929 was about 4 percent greater than in the corresponding months of the previous year. This estimate is supported by the high level at which both pig iron and steel ingot production was maintained throughout the greater part of 1929.

General industrial plants.—The general manufacturing plants which report

quarterly to the Bureau of Mines, show a smaller increase in their rate of consumption than certain other groups of consumers, probably due in large measure to the tendency to close down the isolated steam plant of the individual factory and to purchase power from the electric public utilities. In spite of this tendency, a group of nearly 2,000 large industrial plants showed a consistent increase in the rate of coal consumption in the first three quarters of 1929 over that for the same months in 1928. In February-March these plants showed an increase of 3.6 percent over 1928, in May-June an increase of 2.0 percent, and in August-September an increase of 0.1 percent.

Retail trade.—Indications are that the retail trade also improved somewhat in 1929. During February and March deliveries made by a group of representative coal dealers scattered throughout the country were approximately the same as in the previous year, but in the next quarter these dealers reported a gain of 2 percent in their rate of deliveries, while in August and September an increase of 3.6 percent is shown in the rate of deliveries, when compared with the same two months in 1928.

Beehive coke.—Due to the great activity in the iron and steel trades, the beehive coke industry experienced a revival in 1929. As a result, there was a large increase in the coal consumed at beehive coke ovens. During the year a total of 9,539,000 tons of bituminous coal was consumed in the manufacture of beehive coke. This is an increase of 35.9 per cent when compared with the quantity consumed in 1928.

Other consumers.—As the amount of coal required for the generation of power at the mines tends to vary in direct ratio to the quantity of coal produced, it is believed that this item of consumption likewise increased in 1929. The foreign bunkering business remained practically unchanged, a total of 3,827,249 gross tons being supplied to vessels engaged in foreign trade in the year 1929, as against 3,834,128 tons during 1928.

Trend of Spot Prices

In spite of the greater consumption in 1929, prices were far from satisfactory. In fact, during the first six months of the year *Coal Age* reports that spot prices for the country as a whole declined to an average of $1.755, the lowest figure since 1916. The average of $1.79 for the year was 1 cent below that for 1928 and, the lowest since 1915. Toward the end of the year prices improved somewhat. In the third quarter they rose to an average of $1.77, and in the last quarter to $1.88, which is the highest level of prices of any quarter in the past two years. It is stated further by *Coal Age* that, with the exception of 1926 when there was an abnormally heavy demand for export coal due to the strike of British miners, this increase in spot prices during the closing quarter of 1929 marked the first definite upturn in the progressive decline in prices which has extended from 1923.

Trend of Fuel Efficiency

With the expanding market for coal in 1929 there was no indication of any abatement in the progress of fuel efficiency. The electric public utilities, for example, used 1.76 pounds of coal per kilowatt-hour of electricity produced in 1928, while in November, 1929, only 1.64 pounds of coal were required.

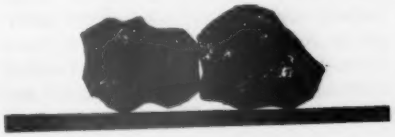
Another indication of the steadily increasing fuel efficiency is the record of freight and passenger service operating statistics of Class I steam railways, published by the Interstate Commerce Commission. For the 10 months ending October, 1928, 125 pounds of coal was used per 1,000 gross ton-miles in freight service and 14.9 pounds of coal per passenger-train car-mile. Comparable figures for 1929 show that the amount of coal required in freight service had declined to 123 pounds per 1,000 gross ton-miles, while the amount used in passenger service had been reduced to 14.7 pounds per passenger-train car-mile.

The iron and steel industry furnishes still another check on the trend of fuel efficiency. Here again there is unmistakable evidence that coal consumption per unit of product declined during the year.

Liquidation of Excess Capacity

One encouraging feature of the market revival in 1929, is that it was not accompanied by a situation that favored the opening of new operations, or the reopening of old and abandoned mines as has so often happened in the past when market conditions improved. The low prices that prevailed throughout most of the year discouraged any such inclination and it is probable that there was a further reduction in the excess mine capacity and excess labor force during the year.

Information regarding the progress made in the liquidation of excess capacity in 1929 is lacking, but figures recently compiled by the Bureau, clearly show the trend in this direction through 1928. From 1923 to 1928 the number of commercial mines in operation declined from 9,331 to 6,450, a reduction of 2,881 mines. During the same period the number of men on the pay roll declined by 183,000, or 26 percent. Not only was the number of men employed in bituminous mines less than in 1923, but the number on the pay rolls in 1928 was actually less than the number engaged in the industry before the war.



Despite the increased efficiency that is apparent throughout the industry, this wholesale elimination of mines and miners has brought about a sharp reduction in capacity. Assuming a potential working year of 280 days, it is found that the capacity of the bituminous mines has declined since 1923 by 191,000,000 tons. The mines that have managed to survive, however, now work more steadily, as the average working time increased from 179 in 1923 to 203 days in 1928.

Progress in Engineering

The year 1929 is further notable for the advances made in the field of mining technology and coal preparation. Many old plants were remodeled and a large number of both wet and pneumatic cleaning plants were constructed. The introduction of mechanical loading in many producing fields of the country continued at a rapid rate throughout 1929.

Of outstanding importance in this field is the constructive work of the American Mining Congress in stimulating interest in improved methods of mining technique and, in particular, the comprehensive survey of mechanized mining which the Congress has vigorously prosecuted during the past year.

Merchandising Progress

An active interest was taken in the problems of merchandising and distribution during the year. Among the trends were the increasing interest in automatic firing, smokeless combustion and thermostatic control in the field of household heating. In the past few years particular attention has been given to automatic firing devices for use by the small consumer. The introduction of the oil burner and the gas furnace have taught the householder the convenience and luxury of automatic and thermostatic controlled heat. To meet this competition a number of small automatic stokers for burning fine sizes of coal have lately been placed on the market. With the exception of the problem of ash removal, this equipment offers practically all the advantages of oil and gas, and within the last year a stoker with ash removal facilities has been developed. According to reliable sources, there was a notable increase in the sales of small stokers in 1929.

Competition from outside sources is being met by the coal industry in various other ways as (*Continued on page* 64)

Bituminous Coal and Industry

By HARRY L. GANDY *

BITUMINOUS coal rides industrial wave—Manufacturing expansion founded on Nature's lavish provision and the initiative of our people—Temporary check on production increase in recent years caused by efficient utilization—Wasteful use of petroleum and natural gas also a check—Hydro-electric power generation must in the ultimate be supported by coal.

IT MAY well be a source of pride to any man to be associated with an industry which plays so vital a part in the lives of his fellow-men as does the bituminous coal industry. How dependent mankind is on bituminous coal, both in its domestic and its industrial life, has often been pointed out, but that dependence is so great that it can not well be overemphasized.

It is my purpose to develop in some detail the relationship between bituminous coal and industry, but I will take a moment to point out that even for household heating bituminous coal is the most widely used fuel. While it is true that anthracite coal is primarily a household fuel and its so-called steam sizes are practically a by-product, the amount of bituminous coal used for that purpose exceeds the amount of anthracite so used by something like 50 percent. The widespread attention now being given to improved methods of burning bituminous coal in household furnaces is a clear indication of the fact that the use of bituminous coal for that purpose will not only hold its own in the future, but expand.

In turning now to the consideration of the special phase of the bituminous industry on which I have been asked to write, let me begin by showing the statistical basis for the statement that the world has never seen anything comparable with the industrial development of the United States. The same story is told whatever phase of industrial life we use as a measuring stick. The two most significant indications of that growth are the statistics of transportation and the statistics of manufactures. Let us look at the latter as covering a longer period and being more nearly complete.

The census of 1850 showed the value of the products of the manufactures of 1849 as one billion dollars; in 1870 this amount had increased to over three billion dollars; in 1890 to over nine billion dollars; in 1910 to over 20½ billion; in 1919 to over 62 billion dollars. Unfortunately these figures are not an accurate indication of the physical growth of the manufacturing industry since they are affected by changes in the value of money. It is well known that fluctuations in the value of money partly account for the abnormal increase between 1909 and 1919, as well as for the fact that in 1927 the total value of the products of manufactures had not increased beyond 63 billion dollars in spite of a large increase in physical output.

Many factors have contributed to this unprecedented industrial development. The energy and self-reliance of our people, the absence of fixed economic classes and the accompanying freedom of individual initiative, have been important contributing factors, but they could have accomplished comparatively little if they had not had an abundance of raw material upon which to expend their energy. Fertile soil, timber of all kinds, metals and minerals alike, existed in great abundance. Among these raw materials bituminous coal occupies a position of primary importance.

The three and one-half trillion tons of bituminous coal estimated by the Geological Survey to lie within 3,000 ft. of the surface of the earth constitutes 45 percent of the total known coal resources of the world. Of this enormous coal reserve many billion tons are of exceptionally high quality, adapted for different industrial uses. Out of this enormous reserve we draw an annual supply running in recent years between 500 and 525 million tons. This output is more than double that of Great Britain, its nearest competitor, and constitutes nearly 45 percent of the output of the entire world.

If one were asked to name the most distinguishing characteristic of American industry, he would make no mistake in citing as such characteristic the development and application of mechanical power. The rapidity with which the amount of such power available for use in American industry has increased is impressive, but even more significant is the extent to which intelligence on the part of the designers of automatic machinery has extended its application into more and more complicated forms of industrial activity. In a figurative, but very real, sense, the increase in the intelligence of mechanical appliances is more surprising than the increase in their horsepower.

It is primarily as a source of mechanical power that bituminous coal has played its part in the industrial development of the country. It is possible to distinguish three periods in that development. In the industry of the early nineteenth century falling water, and to a lesser extent moving air, were the only sources of power supplemental to the use of wood. The last three quarters of the century saw bituminous coal, supplemented to a certain extent by anthracite, become the chief source of power. During the twentieth century, with its utilization of electric current and internal combustion engines, petroleum and its products have come to play a considerable part in our industrial life, and the energy of falling water has again come to the front as a means of generating electric current. However, it is still true that bituminous coal furnishes the larger part of our industrial power, and it is the one and only source of energy whose use

* Executive Secretary, The National Coal Association.

could be expanded to replace any deficiency in other sources.

Nothing brings out more clearly the part that bituminous coal has played in the mechanization of the country than a comparison between the growth of industry and the consumption of bituminous coal. Such a comparison is made by decades since the Civil War in the accompanying table, in which the value of the products of manufacture is again taken as the measure of the industrial growth of the country. As another interesting and significant factor in the movement, the third column shows, from 1889 on, the annual supply of energy from mineral fuels and water power in the United States, as estimated by the U. S. Bureau of Mines.

Year	Value of products of manufacture	Annual supply of energy in trillions of B. t. u.'s	Average annual production of bituminous coal, previous decade
1869.....	$3,386,000,000	.....	11,500,000
1879.....	5,370,000,000	.....	30,000,000
1889.....	9,372,000,000	4,316	76,000,000
1899.....	13,000,000,000	7,426	138,400,000
1909.....	20,672,000,000	14,182	302,500,000
1919.....	62,418,000,000	18,883	471,700,000
1927.....	62,718,000,000	24,741	508,200,000

The relation between these quantities and their relative rates of increase can be seen more clearly from the following table showing the percentage of increase for each factor from one decade to another.

Period	Value of products	B. t. u.'s	Bituminous coal production
	Percent of increase		
1870-1879.....	58.6	....	160.9
1880-1889.....	74.5	....	156.6
1890-1899.....	38.7	72.1	82.1
1900-1909.....	81.2	91.0	118.6
1910-1919.....	160.1	33.2	55.9
1920-1927.....	67.8	31.0	7.7

This table brings out very clearly the dependence of industry upon bituminous coal as its source of power during the earlier decades. The increased use of power, the increased consumption of bituminous coal and the growth in the products of manufacture went hand in hand. It is only during the present century that the increase in the consumption of bituminous coal has lagged behind the industrial growth of the country. During the latter half of the nineteenth century, the period during which the United States passed from an agricultural to an industrial country, every expansion in industry meant a corresponding increase in the consumption of coal. It was only because of the unrestricted supply of that fuel at low prices that such a rapid expansion of industry could take place.

The reasons for the decline in the growth of bituminous coal consumption in recent years have been frequently pointed out. In a word, that decline is to be explained by the encroachment of rival sources of power, especially petroleum products and water power, and by the improved methods of applying power, which have tremendously increased the amount of useful work performed by a given amount of power.

I need not quote figures illustrating the extent of these developments. Everyone is familiar with the great reduction in coal consumption required by locomotives to move a given amount of freight, or by public utility plants to produce a given amount of electricity, or by industry in general in the generation of steam. While improvements of this sort affect adversely the demand for coal for the time being, they are an essential phase of the industrial progress of the time and are welcomed by the bituminous industry as forerunners of an expansion in the demand for coal in the future.

Towards the encroachment of petroleum upon the field of power production the attitude of the bituminous industry is naturally somewhat different. It can not be expected to be indifferent toward a condition brought about by the uneconomic overproduction of a rival fuel and the wasteful utilization of that fuel for unworthy purposes. A sound policy of conservation, based upon a far-sighted regard for social welfare, would long since have checked the production of petroleum and the resulting uneconomically low price of this rival fuel. The competition of fuel oil does not represent a real advance in industrial conditions, but rather a temporary disturbance to which the bituminous industry finds it necessary to adapt itself, at a great loss not only to itself but in the long run to the country as a whole. However, it can look forward to the future with the confident expectation that through the rapid exhaustion of our petroleum resources the supply of petroleum must soon begin to decline, the price of fuel oil must rise and then the field of power production be practically abandoned by it.

The competition of hydro-generated electricity with steam-generated electricity has already passed its peak. All experts in the field of electric power generation agree that through the improved methods of generating current by the consumption of fuel, and through the utilization of the most favorably located water sites, the time has come when only exceptionally promising hydro-electric developments will be economically profitable.

In other words, the competition of

Harry L. Gandy

hydro-generated electricity is already on the decline and the competition of petroleum, while still maintained through excessive overproduction, may be expected to decline rapidly in the reasonably near future. Then again the curve of bituminous coal consumption will follow the curve of expanding industry, modified only to the extent to which more economical and efficient methods of utilizing coal reduce the quantity required for a given purpose.

So many of these improvements in the art of combustion are now under consideration or actually taking place that they amount to nothing less than a revolution in power generation. I need only refer to the possibilities connected with the consumption of powdered coal, or the astonishing gain in the utilization of the many valuable constituents of coal made possible by low temperature carbonization and liquefaction, to give an imperfect realization of the great changes in fuel consumption that lie before us.

With these considerations in mind, the check to the expansion of hydro-electric plants and the decline in the use of petroleum as industrial fuel on the one hand, and the possibilities of industrial expansion resulting from economies in coal consumption and utilization on the other hand, the bituminous mining industry can and does look forward with confidence to a renascence of the condition under which the expansion of our manufacturing and transportation industries and the increase in the consumption of bituminous coal will again go hand in hand.

TEN YEARS of MECH AN

Progress of mechanized loading reviewed over 10-year period—Early types of machines illustrated—Increasing number of installations in 1929—Cooperation between companies is tending to reduce experimentation.

THE completion of the 10-year period, 1919-29, suggests that we recall how much progress has been made in mechanization in the decade. The first general discussion on mechanical loading by members of the American Mining Congress was held at the St. Louis meeting of the Congress in 1919. No statistics are available to show how much coal was loaded per year mechanically nor how many mechanical loading devices were in service prior to 1923. In order to discover what the actual status of mechanical loading was, we may review the technical literature of the period 1919-1921, we may consult the manufacturers of mining machinery, and we may advise with the men of the industry who were in position to know what was being done at that time in the various fields.

At the 1918 meeting of the Coal Mining Institute of America, E. N. Zern presented a classic paper on "Underground Coal-Loading Machinery." According to this review there were then on the market two types of mining and loading machines, four types for shoveling and loading, one shaking conveyor, one type of pit-car loader, one type of scraper, and the large electric shovel for thick beds. Mr. Zern expressed the hope that "within the next decade these devices would be as common in mining practice as coal-cutting machinery and the electric locomotive."

In an editorial in *Coal Age*, October 2, 1919, the following statement appeared: "Many attempts have been made to perfect a power shovel or loading machine; some have met with a degree of success while others have been entire failures. It is by no means beyond possibility, or perhaps even probability, that the next few years will see introduced a successful loading machine capable of application in beds of even average thickness."

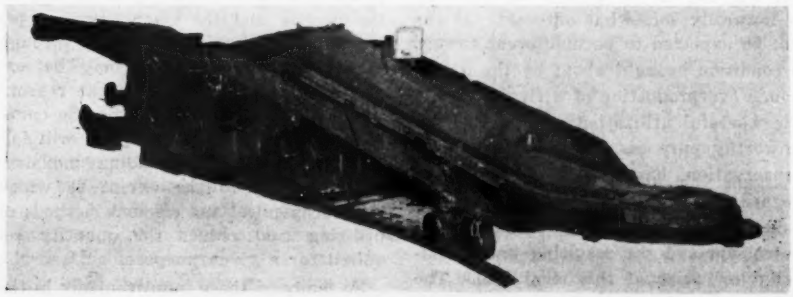
Judging from these statements there was not prevalent in 1919 and 1920 any feeling that mechanical loading devices applicable generally to mining conditions had been developed although at that time the Myers-Whaley and several other machines, in practically their present form, were on the market. As a matter of fact the machines were available but mining practice had not been developed to use these machines effectively.

According to Mr. D. A. Thomas "there was only one mechanized mine in the Alabama District 10 years ago. This was the Montevallo mine at Aldrich which was equipped with Jeffrey chain conveyors on the long-wall system.† A shaking conveyor, purchased in Scotland, was installed in this mine in 1921," this being the first shaking conveyor installed in a coal mine in the United States. "The tonnage produced at the present time by mechanization as compared with 10 years ago has increased many times. The mechanical units installed at these various mines make it possible to recover some tonnage that otherwise might not be recoverable on an economic basis."

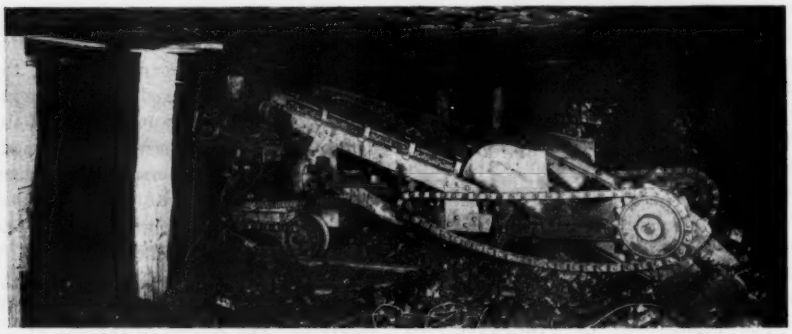
In June, 1920, the Goodman Company sent its first three-drum automatic rope hoist with entryloader to the Coal Run

• Vice President, Pittsburgh Coal Company.

† The first long-wall conveyor, 270 ft. centers, was furnished by the Jeffrey Company on order from Mr. Clarence Claghorn, Vintondale, Pa., in 1902.



First Coloder installed in 1918—four more of this type were placed in service by 1920



First Myers-Whaley loading machine installed in a coal mine at Windrock, Tenn., in 1908

One of four Joy machines built for the Pittsburgh Coal Company, used 1917-1919

One of the first Joy machines, 1916

CHANIZED LOADING

By DR. L. E. YOUNG*

Mining Company at McIntyre, Pa. Previously—during 1915 and 1916—Mr. Cadwallader Evans had used a two-drum scraper loader in the mines of the Delaware and Hudson Company.

A Jeffrey entry-driving machine and Myers-Whaley shovels were being used by the Pike County Coal Company to develop a mine at Petersburg, Ind., and it was in December, 1920, that the first Indiana wage agreement was made covering mechanical loading. As a result of paying $12 to the machine operator and later $8.14 to the helper, a compromise scale was paid by other operators, and thus the $10.07 rate, now being paid in Illinois, was established.

In 1919 the Pittsburgh Coal Company was experimenting with four types of machines and succeeded in loading with machines a total of 70,341 tons. In the five years previous to 1919 the company's mechanical tonnage was 107,843.

After a number of years of experimental work a machine of the type of the present Coloder was built in 1916. Improvements were made on this machine and five were built in the years 1917 to 1920 for use in the mines of the Pocahontas Fuel Company. Ten years ago that company was probably loading more than half the coal mechanically loaded in the United States.

In 1925 there was published Bulletin 17 of Coal Mining Investigations under the auspices of Carnegie Institute of Technology, United States Bureau of Mines, and the advisory board. In this report the authors, Mr. F. E. Cash and E. H. Johnson, reviewed field investigations on "Mechanical Loading in Coal Mines," and covered the period from May, 1924, to May, 1925. They described various types of mechanical loading devices excluding rock handling machines and large shovels, as follows: Mining and loading 4, shovelling and loading 10, pit-car loaders 2, scrapers 5, shaking conveyors 3, other types of conveyors 7.

Since 1925, there has been increasing interest in mechanical loading as is evidenced by the large increase in types of mechanical loading devices being manufactured. The 1929 Mechanization Year Book lists 56 different types of equipment, including 15 loaders, 22 conveyors, 13 pit-car loaders, 6 scrapers, while the 1928 edition showed a total of 33, including 10 loaders, 18 conveyors, 2 pit-car loaders, and 3 scrapers.

At the end of 1928 there were 125 loading machines and 867 pit-car loaders installed in Illinois, and at the end of 1929 there were 185 loaders and 1,750 pit-car loaders. One of the manufacturers of loading machines reports delivery of more than 100 units in 1929; a manufacturer of pit-car loaders reports the sale and delivery of over 500 units in 1929, which was a 20 percent increase over 1928.

Without final statistics available it is impossible to do more than note apparent trends in 1929 and 1930. The outstanding feature from a quantitative viewpoint is the tremendous development in Illinois largely as a result of the use of loading machines. Late in 1928 there

First Oldroyd machine, designed in 1917 and installed in 1919

First Jeffrey pit-car loader, 1916

Jeffrey 3½-B in use in Somers Mine, Pittsburgh Coal Company, in 1917

were indications that this movement was coming. Apparently the year 1930 will witness the extensive installation of the large-tonnage machines particularly in the Middle-West. The outlook for this type of equipment in Pennsylvania and in the Rocky Mountain states is improving and the development of low-type machines will undoubtedly extend the field for mechanical loading generally.

During the past year there has been an increasing use of the pit-car loader in western Pennsylvania and northern West Virginia, particularly where roof conditions do not permit the use of the large-type of loading machine.

The use of face conveyors and the shaking conveyor with the duckbill has been extended. Commendable progress has been made in mining seams 3 ft. thick and less. By the use of the face conveyor in such seams the capacity of the shoveller is doubled.

The manufacturers have supplied better machines and the electrical problems of permissible types are being solved. Several new machines are being offered and before the end of 1930 they should pass the experimental stage if they are to find general use.

The drive for increased tonnage per loading machine is resulting in the use of longer cutter bars on cutting-machines, concentration of working places, more thorough preparation of the face, and better coordination of transportation. These progressive moves make still greater demands for speed in development and will require even more careful consideration of tonnage per man at the face, tonnage per day man, tonnage per working place, and tonnage per dollar invested in machinery on the territory.

The progress made by the Mechanization Committee in 1929 was due primarily to the whole-hearted support of the industry and the cooperation of the members among themselves. In this connection it is worth while to note the following from the editorial page of *Colliery Engineering* (London), July, 1929: "Independent data afford the mine manager the best possible basis on which to formulate his plans and should do much to help him to form an accurate opinion as to whether, in any special case, a conveying installation is justifiable. Hitherto the mechanizing of a colliery district has not been free from a highly speculative element and more often than not the experimental method of approach was the only one possible, but the type of knowledge the report (so-called Midland report) makes available will enable the manager to calculate with some degree of confidence the results he may legitimately expect to obtain. He will thus be able to conceive his plans with more boldness and carry out a properly coordinated scheme instead of introducing partial schemes, the piecemeal nature of which dooms them to failure from the outset."

The fact that we have set out on a program of training and education is meeting with hearty commendation. Moreover it is interesting to note that our British friends also have (see "The Supervision of Mechanized Mining," *Colliery Engineering*, January, 1930, p. 4), concluded that "the successful future of mechanized mining lies in its careful supervision by specially trained men, who are experts in this work, together with the training of the men and officials employed."

At the December meeting of the Committee on Mechanized Mining suggestions for the work of 1930 were presented and discussed. Mr. Southward has reviewed these suggestions and submitted them as Mechanization Report No. 30-1 in the January, 1930, issue of this journal. Members are invited to comment on this program and to offer additional suggestions to the committee for consideration at its next meeting.

BITUMINOUS COAL IN 1929

(From page 59)

witnessed by the spectacular rise in the consumption of coke for industrial and domestic purposes. Only a few years ago, coke was consumed almost exclusively by the blast furnaces and foundries. In 1928 a total of 6,333,000 tons of coke was sold for domestic purposes and it is probable that the tonnage was still larger in 1929.

That the industry is keenly alive to its merchandising problems is evidenced by the great attention that has recently been given to servicing, in recognition of the fact that the surest means of building up and retaining new business is by winning the satisfaction of the consumer.

Trade Practices

An encouraging sign is the increasing activity of the local and national trade associations, one indication of which was the response of the industry to the call of the United States Chamber of Commerce for the National Business Survey Conference. All branches of the coal industry were represented at this conference where a counter offensive was organized against the threatened recession of business resulting from the collapse of the stock market.

Another outstanding feature of the year in the field of trade practices and relations was the activity of the Market Research Institute of the National Coal Association. The idea underlying the creation of the Market Research Institute was to coordinate all the activities of the association pertaining to the marketing side of the bituminous industry. The record of the institute during the first year of its existence has been encouraging. A considerable portion of the last convention of the National Coal Association was devoted to subjects dealing with marketing problems and trade relations, and improved marketing methods also occupied a prominent place in the meetings and discussions of the wholesale and retail branches of the industry during the past year.

The local trade associations have hardly been less active than the national organizations. As revealed in the records of their annual and other meetings and from other sources the local associations of the various branches of the industry have evidenced a thorough grasp of their pressing problems and a vigor and skill in grappling with their solution that have already brought about definite progress and promise even greater results through cooperative action in the future.

Of chief significance among the developments of the year in the field of local association activities, perhaps, are those relating to the subject of marketing practice and methods, notably in the growth of the so-called trade practice movement. Eight local associations of producers are reported to have already joined in this movement and the adoption of fair trade practice codes is under consideration in other important fields. The prompt and definite beneficial results reported by associations operating under codes of fair practice rules have given impetus to the movement which bids fair to assure its substantial growth in the near future.

Although devoid of sensational features, the coal industry has witnessed many interesting and significant events and trends in the past year. The limits of this article have permitted but a brief account of some of the more important developments but these will perhaps suffice to outline the general course of the industry and to sum up its position sufficiently to enable the reader to place the year that has just passed in its proper relationship to others in the history of bituminous coal.

Taken as a whole, the record of 1929 is one of definite, if gradual, progress in the bituminous coal industry and one which should lend encouragement to the view that a permanent momentum toward the goal of a stabilized and profitable industry has become an accomplished fact.

RESEARCH and USES for COAL

By THOMAS STOCKHAM BAKER *

Research occupying attention of far-seeing leaders in all industries—Present condition of coal industry demands radical departure from old methods and traditions—The laboratory the open door to the future

RESEARCH is a subject that is uppermost in the minds of the presidents of most of the American universities. It is a subject that is occupying the attention of the far-seeing leaders of the great American industries. To the latter, research means greater production, greater economies, reduction in labor, greater profits. To the college executive, research means the advancement of science, an increase in our knowledge of nature, and the possibility of finding an explanation of natural phenomena. Industrial progress is impossible without scientific progress, but we would make a mistake if we were to believe that the sole reason for scientific inquiry is the advancement of industry. The university laboratory must be devoted to the pursuit of truth, quite regardless of whether the results are of practical benefit or not, but we may feel sure that as our knowledge is broadened and deepened our power to control the forces of nature is enlarged. Science has made rapid advances in the recent decades, but the eagerness and ability to apply the results obtained in the scientist's laboratory have progressed with even greater rapidity. There is hardly an industry in this country which at the present time is not making an effort to secure some of the profits which are obtainable through the application of recent discoveries in physics and chemistry.

The United States possesses one-half of all the known coal deposits of the world. If we attempt to forecast the course that civilization is likely to follow, we shall be compelled to keep before us the significance of this magnificent and precious national asset. The nation that has the richest resources in power may or may not nurture the loftiest form of culture, but it can hardly fail to impose many of its ideas and ideals upon the rest of the world. It becomes a leader among nations because of its great store of energy. Our wealth of coal assures to our country a long continuance of its industrial greatness. It is one of the most cogent reasons for believing that the citizens of the United States will for many generations live under conditions of material well being. Prosperity and the refinements of life that are dependent upon wealth are impossible without ample and cheap power, and undoubtedly coal will serve as the chief source of energy until some revolutionary discovery makes obsolete the physical theories of today. Even though we may harness every stream and water course in the whole country, the electricity thus gained will hardly furnish more than a third of the power that will be demanded by the generations that are to come.

In an address which I gave at the First International Conference on Bituminous Coal, which was held in 1925 at the Carnegie Institute of Technology, I said: "Far-sighted men of affairs must perceive that something more than financial resources is necessary for commercial progress. Modern business demands two kinds of capital, money and technical and scientific knowledge. A well-organized staff of research men can achieve results in a busines way which can not be secured merely by great credits."

Research is a curse and a blessing. It is a curse to those individuals who do not employ it, and who are in competition with those who utilize scientific experience and technical skill. It is a blessing to those enterprises which owe their progress to the methods of the scientist and the skill of the investigator.

Every important step forward in technology is accomplished at the expense of some industry, while bringing profit to some other. The introduction of the electric light was a severe check, although short-lived, to the gas industry. The coming of the automobile dislocated a number of established business traditions. The discovery of the method of making alcohol from coal gave a blow to the wood-alcohol industry. Finally, science in teaching us how to make power economically has done a disservice, at least for the time being.

The coal man is baffled by what is taking place around him. He observes the curve which shows the consumption of power mounting rapidly. But the consumption of his commodity, which must serve as the starting point of this rapidly swelling flood of machine-made energy, rises very slowly from year to year. So far research to him has been anything but a benediction. Research has taught his clients literally how to make two blades of grass grow where only one grew before. His chief hope for the future must lie in adopting some of the methods of his customers. If, with his present system, he can not secure an adequate return for his commodity, it behooves him to call to his aid the engineers, and the men of science, who are, in a measure, responsible for his unsatisfactory condition.

We see on every hand inroads being made into the coal industry by new engineering and scientific developments. The railroads are moving more of their trains by electric power, generated, in many instances, not from coal. The improved stokers mean a more economical use of fuel. We hear of the newly developed oil-electric locomotives, which are supplanting some of the coal-burning en-

* President, Carnegie Institute of Technology. Presented to 32nd Annual Convention, The American Mining Congress, December, 1929.

gines. These developments to which I have referred represent engineering skill, and they have been accomplished at the expense of the coal producer. It is extraordinary that so much thought, so much patient study should have been given to the saving of a commodity which is cheaper in this country than in any other part of the world. Because it is so cheap, one might ask, why be so thrifty. The coal producers may have thought their product too inexpensive to study, but the men who buy from them have taken an opposite point of view. The progress of fuel economy can be explained, at least partly, by the fact that the greatest consumers of coal are our great industrial organizations. It is they who practice efficiency in the highest degree. They have carried the farthest the conception of the integration of small plants into large units in their efforts to achieve good management. The improvements are the inevitable results of the programs of big business. We should not like to return to the era of the wasteful methods of the small power house, but we may well ask what the coal industry has done to combat or rather to match the engineering skill of the power industry or the railway industry. As the markets have been narrowed, it has not been possible to think of new ways of utilizing the output. The problem is to find new uses, new outlets, new employment for this commodity, and far-sighted men in this country and in Europe are already beginning to see that science can help in finding the answer. In Germany and in France they are uniting to support great laboratories, where work of high scientific significance is being done, although the objective is to secure from coal a greater value than can be gained by selling it merely as fuel. A great many of the studies of these laboratories are still in the preliminary stages, and even if successful might not be adaptable to conditions in our country.

In all countries a search is being made for a satisfactory low temperature distillation process. It is of the highest economic importance. It will increase the value of coal. It will provide a cheaper substitute for anthracite for domestic purposes by transmuting low grade bituminous coal into high grade fuel. It will add to our supply of motor spirits. In addition, it will increase the available supply of gas, which is becoming more and more important in the life of every great city.

A development in coal chemistry of extreme interest is the production of synthetic petroleum from coal. We in this country have little conception of the feverish efforts that are being made in Europe to make coal a more valuable commodity. Much of the research that is being carried on is concerned with processes of turning coal into substitutes for gasoline and the heavier oils for Diesel engines and for burning under boilers. The explanation of the eagerness to achieve this transmutation is easily understood. The man who solves this problem will not only settle an economic question of the greatest importance but he will go far toward making the countries of Europe self-sustaining should another war arise. It has been stated that although Great Britain sends abroad in normal times many millions of tons of coal in a year, she imports more thermal units in the form of petroleum products than she exports in the form of coal.

The Germans and at least one Frenchman have achieved the liquefaction of coal. The processes are successful if we disregard the question of costs. But at the present moment the German Dye Trust is selling synthetic motor fuel prepared according to a modified Bergius process on the streets of the German cities and claims that the production of the new commodity is profitable. It would seem that Americans would have little interest in synthetic petroleum, but in spite of our over-supply of mineral oil, the Standard Oil Company of New Jersey has found it worth while to secure the rights to the process employed by the Dye Trust and is building a great plant to utilize it in some way.

One of the far-reaching discoveries in an economic sense of the coal chemist is the production of synthetic fertilizers. The beginning of this new industry was made by the German chemist, Haber, when he invented his process for the fixation of atmospheric nitrogen by ammonia synthesis. This discovery rendered Germany independent of the nitrate fields of Chile from which had been drawn, up to that time, the nitrates essential for explosives. In a sense it can be said that Haber was responsible for prolonging the war. Without his process Germany would have succumbed earlier. Since 1918 his methods have been modified and other similar processes have been developed. In all cases, however, coal plays a large part. At present these discoveries are employed chiefly in the production of fertilizers, with the result that the agricultural condition of Germany has been vastly improved. In our own country they are of equal importance. If cheap fertilizer can be secured, we can see at least a partial solution of our difficult agricultural problem.

I have been able to refer to only a few of the methods of utilizing coal as a raw product. Enough has been said, however, to show that we are at the beginning of a new epoch in the history of coal which may even change some of the aspects of our civilization.

It is hardly likely that any campaign of salesmanship or propaganda could be planned that would increase the sum total of coal to be consumed as fuel. The nation takes what it needs and no more. Certain companies may be able to expand their sales by skillful merchandising methods or through their special facilities for meeting the desires of their customers. But this will be accomplished at the expense of their competitors. It would then seem that the most likely way to increase the value of the coal industry would be to increase the value of coal, and it is here where the scientist can be of most help. In Pittsburgh we produce probably more steel than in any other city in the world. The cost of this commodity is comparatively low. But if it is fabricated it becomes more expensive in proportion to the amount of work that is put into the process. Doubtless Pittsburgh would be a richer city if more of this manufacturing took place within her borders.

In our district we also produce a great amount of coal, and in time it may be profitable for the mine owner to fabricate, so to speak, his product and thus add to its value and to the wealth of the community. This conception may at present seem rather hazardous and its carrying out must be treated not only by scientists but by practical men of affairs. In Europe the tendency of the mine owner to take on some of the functions of the manufacturer is going forward with considerable speed. With us the impulse in this direction is weaker because coal is cheaper.

We can not foresee in just what respects science would cure the ills of the coal industry. We may be certain that it would not banish them as if by magic, but we may be confident that some of the apparently insurmountable difficulties will yield to the patience and hard work of the investigator.

The modern science dealing with fuel may draw to the coal fields new industries which were not thought of a generation ago. The processing of coal will produce great quantities of gas which formerly was wasted, but which in the future may be combined with atmospheric nitrogen to produce nitrates or piped to distant cities, so that some day the gas that is burned in New York may come from the coke ovens of Pennsylvania. The processing of coal will also produce great quantities of tar which will be distilled probably near the mines and the various stages of refining will create new enterprises out of what are now only laboratory experiments. Chemical industries are likely to draw more and more closely toward the coal fields. We can hardly conceive of conditions arising under which localities where coal is situated will not grow in importance. The newer chemistry will bring about new industrial developments, many of

which will take place in the regions where the basic material is to be found. Whatever may happen to other parts of our country we can prophesy that those regions where soft coal is to be found will enjoy an ever-increasing activity and probably an expanding prosperity.

I realize that there are many complications to be adjusted when the coal man departs from his traditional work of mining and selling; the finding of markets for the new commodities, the disarrangements of established methods, the risks of insufficiently tested new processes, the inertia of tradition; but the present conditions of the business seem to demand a radical departure. The coal men might feel encouraged to take some chance in this direction because other industries are finding it advantageous to purchase and work coal mines. The chemical industry, the coke industry, the fixed-nitrogen industry, the gas industry, are drawing their raw materials from mines which they have acquired.

There is hardly a coal company so large in this country that it would feel justified in setting up the kind of research organization that the conditions demand. But much could be accomplished if a group of companies would unite in supporting a common program of investigation.

It is essential that such work be concentrated in a few centers. Much is to be gained through the cooperation of considerable group of workers. The allocation of problems piecemeal to a large number of laboratories make it impossible to secure the benefits that are to be had from the daily exchange of views between men who are working on problems that are closely allied.

The first essential is to get something started and under the direction of well-trained and far-sighted men. If results could be shown, I believe the scope of the studies could be enlarged rapidly and the support that is essential could be secured. Combined with this research program there should be offered opportunities for technical training. We are entering upon a new era of fuel technology, and the demand for men educated in the new science will be very insistent.

It may appear impertinent for a university man to attempt to tell the members of the coal industry what they are to do. This is not my intention. I can only point out what has been accomplished in other countries, and I can emphasize with great satisfaction the marvelously fruitful achievements of science in certain other industries.

In November, 1926, an international conference on bituminous coal was held at the Carnegie Institute of Technology. Eighteen foreign nations were represented. A similar international conference was held under the same auspices in November, 1928, at which were present scientists from 20 nations and 2,000 delegates. I am happy to announce that a third International Conference on Bituminous Coal will be held at the Carnegie Institute of Technology in 1931. Scholars all over the world are working eagerly to unlock the riches that are contained in bituminous coal. It is expected that at the conference two years hence many discoveries of great importance will be announced.

In organizing the congresses of 1926 and 1928 we have had the hearty assistance and cooperation of the American Mining Congress. I want at this time to offer my thanks for the valuable aid that we have received from the officers and members of this organization and to invite most heartily the American Mining Congress to participate in the conference of 1931. We shall endeavor to make it even more serviceable to the coal industry and allied industries than the meetings of 1926 and 1928.

UNDERWRITING ENABLES STANDARDS ASSOCIATION TO EXPAND WORK

Underwriting of the finances of the American Standards Association for a period of three years to permit a total annual expenditure of $150,000 for the association's work is now being completed, according to an announcement made by William J. Serrill, president of the A. S. A. This fund permits an increase in the 1930 budget of $80,000 over the previous budget of the association and is expected to result in an expansion of national standardization work affecting practically all industries.

The fund is being underwritten by a large group of industrial organizations. The underwriting was arranged by a committee consisting of James A. Farrell, president of the United States Steel Corporation; Gerard Swope, president of the General Electric Company; George B. Cortelyou, president of the Consolidated Gas Company of New York; and F. A. Merrick, president of the Westinghouse Electric and Manufacturing Company.

Because of the rapid growth of the industrial standardization movement in this country, the underwriting was planned to permit immediate expansion of the work of providing authoritative national standards, while permanent financing is under way.

Among the companies joining in the underwriting are: Aluminum Company of America, American Telephone & Telegraph Company, Bethlehem Steel Company, Consolidated Gas Company of New York, Detroit Edison Company, General Electric Company, General Motors Corporation, Gulf Oil Corporation of Pennsylvania, Public Service Corporation of New Jersey, Standard Oil Company of New Jersey, U. S. Steel Corporation, Westinghouse Electric & Manufacturing Company, Youngstown Sheet and Tube Company.

AMERICAN ENGINEERING COUNCIL MEETS

Carl E. Grunsky, of San Francisco, past president of the American Society of Civil Engineers, was elected president of the American Engineering Council at the opening session of the annual meeting of the council held at the Mayflower Hotel, Washington, January 10-11. Mr. Grunsky, who will serve during 1930 and 1931, succeeds Arthur W. Berresford, of New York, past president of the American Institute of Electrical Engineers.

Vice presidents were chosen as follows: L. B. Stillwell, New York, American Institute of Electrical Engineers; Maj. Gardner S. Williams, Ann Arbor, Mich., Detroit Engineering Society; O. H. Koch, Dallas, Tex., Technical Club of Dallas; L. P. Alford, New York, American Society of Mechanical Engineers. Dr. Harrison E. Howe, of Washington, was re-elected treasurer. Lawrence W. Wallace, of Washington, continues as executive secretary.

Present Trends in BY-PRODUCT GAS and COKE Industry*

A modern gas and coke plant at Brooklyn, N. Y. Gas, domestic coke, water-gas coke, coal tar and ammonium sulphate are produced at this plant

By C. J. RAMSBURG †

YOUR Board of Directors invited me to speak on a subject dealing with the future of the coal industry. I have selected as my topic, trends in the manufacture and distribution of by-product gas and coke. The by-product gas and coke industry is one of your best customers. It is second only to the railroads, as the largest industrial consumer of coal. Last year, 76,000,000 tons of coal, or 1 out of every 6½ tons of bituminous coal mined in this country, were carbonized with by-product recovery, and this proportion is increasing yearly.

History does not record the date when coal was first used. After centuries of more or less intermittent use for smithing and metallurgical purposes, coal began to be used in Europe during the Middle Ages as a domestic fuel. The heavy smoke and pungent odors produced by burning raw coal provoked the most bitter opposition, and led to the enactment of many laws to prohibit coal burning, and evening coal mining.

Following the invention of the steam engine in 1763, coal became the symbol of power, and black smoke pouring from factory chimneys became an indication of prosperity. The key position of coal in the industrial development of nations is too well known to require mention before this audience. As a result of these developments coal became recognized at least, as an indispensable, though dirty servant, of civilized man. Its real potentialities were not yet glimpsed.

Manufacture of Coke Without By-Product Recovery

The next great discovery regarding coal, was that it could be transformed by heat into other fuels which were smokeless and of greater value. Two hundred and seventy-three years ago Sir John Winter heated coal in an earthenware pot to burn out the "malignity" and produced a coke which he said made "a clear, pleasant chamber fire."

Even today, in India, hundreds of thousands of tons of coal are coked in open pits to prepare a smokeless fuel for chimneyless huts.

From these primitive methods, the beehive coke oven was developed. Beehive ovens are not entirely obsolete today, in spite of the fact that they consume all of the gas, tar, oils and a part of the coke, thus destroying one-third of the heating value of the coal, as well as all of the chemical values. Beehive coke ovens were wasteful and they polluted the air for miles around with smoke and soot. Less than 10 per cent of the coke now produced in this country comes from beehive ovens, and abandoned, weed-grown beehive ovens are a familiar sight in western Pennsylvania and elsewhere.

C. J. Ramsburg

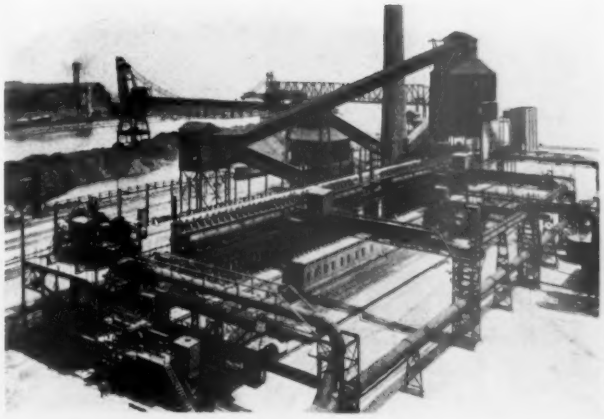
IN 1928 seventy-six million tons of coal, or one out of every six and one-half tons of bituminous coal mined in this country, were carbonized with by-product recovery, and this proportion is increasing yearly —Value of research in coal industry

The Smoke Nuisance

Gentlemen, I cannot refrain from interjecting a few comments on the smoke nuisance. The sun is the great life-giv-

*Address presented at the Thirty-second Convention of The American Mining Congress, Washington, D. C., December 5, 1929.

†Vice President, The Koppers Company, Pittsburgh, Pa.; Director, The American Mining Congress.



Becker ovens heated with blast-furnace gas. Youngstown Sheet and Tube Co., So. Chicago, Ill.

Domestic-coke screening and loading station at a modern by-product gas and coke plant

ing element in our universe. You know the old German proverb: "The undertaker's hearse stops twice as often on the shady side of the street." You have also heard the old Italian saying: "Where the sun does not enter, the doctor enters."

It is hard to over-emphasize the *curse* of smoke. Smoking chimneys, the sewers of the air, not only cause a staggering cost to our communities, but are responsible for a vast amount of human misery, suffering, disease and death. I am talking cold, hard facts, not theories.

During this afternoon's talk, I will limit myself to a discussion of coke and gas because they are the smokeless fuels in which I am most interested. However, I have no quarrel with the use of anthracite or natural gas, nor with bituminous coal and oil when they are burned smokelessly. I welcome the smokeless combustion of any fuel in any locality.

By-Product Coking

The function of the modern by-product coke plant is to produce two clean, smokeless fuels, namely coke and coal gas. Every minute of the 24 hours of every day in the year, 3 battleship carloads of coal go into the bins of the by-product coke plants of the United States. We will assume that all coal mining engineers and executives are interested in an industry which is such a good customer.

Early in the reorganization of The Koppers Company, which took place in 1915, it was felt that research must become an essential part of our business. Arrangements were made to extend this not only to chemical and physical problems, but to engineering design, and the study of materials of construction. This policy has been so successful, that a quick survey of the work of this company will serve to give you a very substantial idea of recent developments in the industry.

In the first place, I would like to mention a development resulting from research in engineering design, a development which pushed the industry further forward at one stride, than any other recent development—namely the Becker oven. So much has been published about this oven that only the barest essentials need be mentioned.

In 1920 the Koppers oven was generally recognized as the best oven design, and was being built all over the world. A man in our organization, Joseph Becker, now Vice President, recognized its faults and limitations, which were becoming serious because of increasing demands for speed, economy of operation, and coke quality. A study was made of every phase of design and operation. After a long investigation, a new oven, the Becker oven, was designed. It had every advantage of the older oven, and at the same time overcame the disadvantages. At a single stroke previous size limitations were cast into the discard, and it became possible to heat the large new ovens with cheaper producer gas or blast-furnace gas, thus releasing all of the valuable coal gas for use or sale.

It took courage to introduce a new oven at a time when the old oven was on the crest of a wave of appreciation. Yet in the 7½ years since the first Becker oven was put into operation, 3,494 of these ovens with an annual coal-carbonizing capacity of 30,000,000 tons have been built in America, and 674 ovens with an annual carbonizing capacity of 5,500,000 tons have been built in England, France, Italy, Russia and Belgium. Are any further comments necessary on the success of this research in engineering design?

Gas Purification

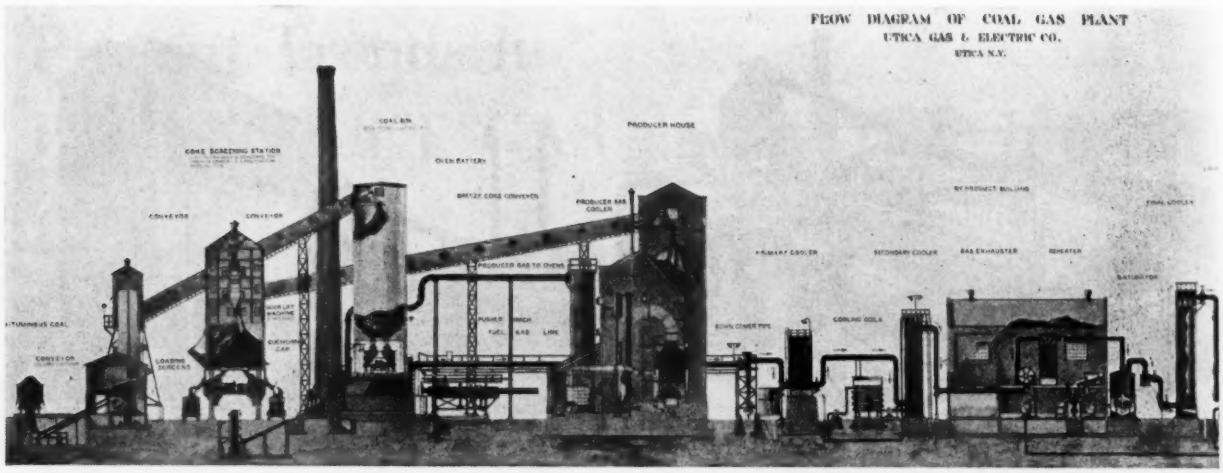
Chemical research has also been most productive. Some of the outstanding developments have been in the field of gas purification, carried out under Mr. F. W. Sperr, Director of Research.

You will recall that after the ordinary by-products have been removed from coal gas, there still remain small amounts of various impurities, of which the chief is the sulphur compound called hydrogen sulphide. In the old-fashioned gas plant this was removed by means of large boxes filled with iron oxide sponge.

Intensive research has developed various processes for removing hydrogen sulphide by means of liquid contact. So successful have been these investigations that seventy of these purification plants are now in operation in this country and elsewhere, including far-away Japan. These plants are purifying not only coal gas, but carburetted water gas, oil gas, natural gas, and gas from the cracking stills of the petroleum industry. New uses are still being found these processes. As is usual in research work, new ideas have led to further developments and to the production of valuable chemical by-products. While the original liquid purification process removed hydrogen sulphide from the gas, without recovery, later developments have made it possible to recover this despised impurity as practically pure sulphur in an extremely finely divided form. This sulphur has been found to have unique characteristics that make it of extraordinary value.

Koppers Flotation Sulphur

Sulphur has long been known as a powerful fungicide. While harmless and even beneficial to human beings, it is sure death to most of the molds, fungous diseases and rusts that attack our garden, field and fruit crops. To be effective against the ever-present fungous attacks, sulphur must be very finely divided, and must be applied liberally and often. Hitherto, agricultural sulphurs have either been too coarse for effective action, or have been too expensive to permit sufficiently liberal use. These limitations have been definitely removed by Koppers Flotation Sulphur.



FLOW DIAGRAM OF COAL GAS PLANT
Utica Gas & Electric Co.
Utica, N. Y.

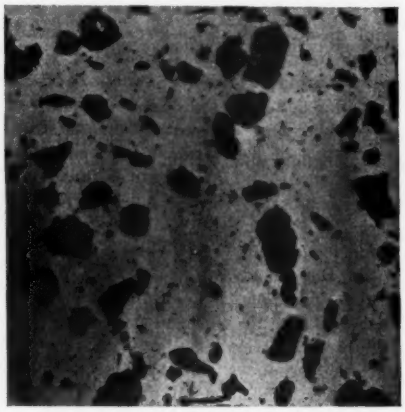
Before we entered this market we undertook to establish the value of these sulphurs by a comprehensive series of field tests. A research fellowship was established under the administration of the Crop Protection Institute, an impartial, fact-finding organization sponsored by the National Research Council. Co-operating with this organization during the past two years were 25 plant pathologists of the leading State Agricultural Experiment Stations in this country and Canada. Our by-product sulphur has been tested under conditions of climate and disease as varied as Nova Scotia and British Columbia, Florida, California, Colorado, New York, Illinois, Arkansas, Virginia and Haiti. Recently inquiries for this sulphur have come from the far corners of the world, from Java, Ceylon and the Malay Peninsula to control diseases attacking plantation rubber trees.

The results of the above field tests conducted under the most careful scientific control have definitely established the fungicidal superiority of these sulphurs in spray or dust form. We can market this sulphur with confidence as to its value, and are already shipping it in carload lots.

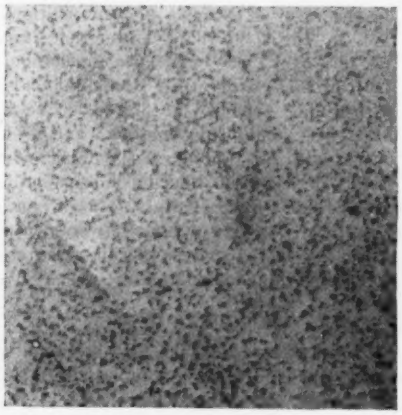
Thiocyanates

Sulphur is not the only by-product of these liquid purification processes. From coal we are now producing ammonium thiocyanate, the starting point for a new and important resin which can be molded similarly to Bakelite, and possesses the advantage of taking and retaining all possible color combinations. This resin can also be made in the water-white transparent grade, capable of transmitting ultra-violet light. It may prove to be a competitor of plate glass, since it is non-shatterable, and can compete in price. You may soon be using "plate-glass" in your automobile windows, and beautiful cups, saucers and plates on your table, made 100 per cent from "soft coal."

Another product is calcium thiocyanate, which has the property of dissolving cellulose, for example cotton or paper. This curious product will dissolve your handkerchief as water dissolves sugar, and the cotton can again be recovered from the solution in a new but useful form.



Commercial precipitated sulphur × 100



Koppers flotation sulphur recovered from gas purification process × 100. Particle size 1 to 3 microns

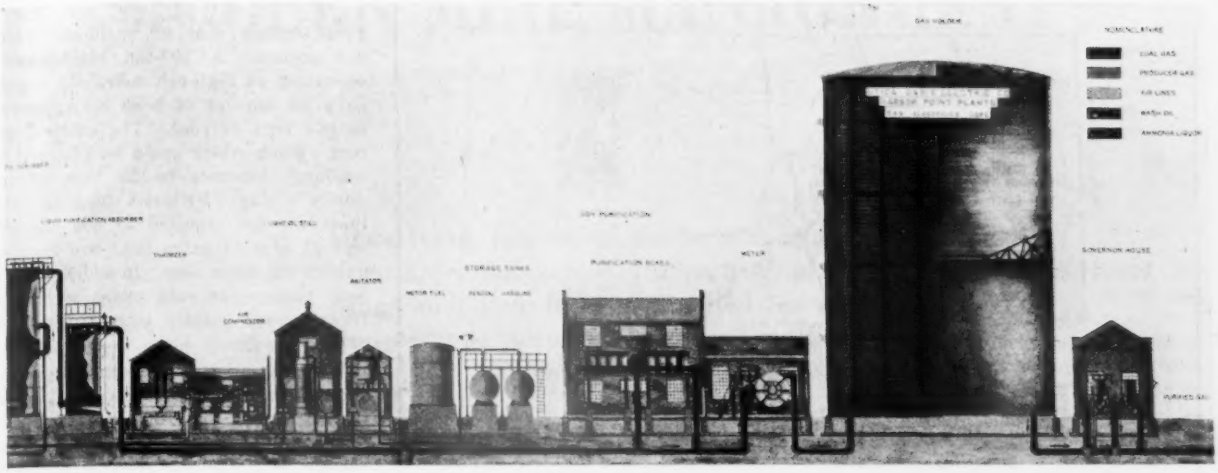
Another most interesting product is sodium thiocyanate. Research at Boyce Thompson Institute has established that a 2 per cent solution jazzes up the germination of potato tubers. Growers in the South and in Bermuda now have a powerful stimulant to awaken the dormant tubers several months earlier than would normally be the case. In some instances this means two crops a year, instead of one.

Still another by-product of these same processes is the familiar photographer's hypo, which can be produced in large quantities.

I cannot take the time to tell you of the many other processes which we have developed for removing impurities such as naphthalene, gummy compounds, and moisture from manufactured gas. These processes are in successful operation at any places in this country and abroad. Some of them produce valuable by-products.

Coal as a Chemical Raw Material

Because the percentage yield of a given coal by-product is small, it does not follow that the quantity produced will be small. Let us assume that coal yields 1/100 of 1 per cent of some hypothetical by-product. The chemist can hardly detect as little as 1/100 of 1 per cent. Yet if this percentage were obtained from the coal coked in the Clairton by-product coke plant of the United States Steel Corporation, near Pittsburgh, 2,000,000 pounds of this by-product would be produced annually. You may be interested to learn that nearly 1 per cent of all the bituminous coal mined *in the entire world* passes into the Koppers and Becker ovens of this great plant.



Research as a Business Necessity

It has often been said that the price of progress is research. That is correct, but I will go further and say that the price of *safety* and even existence in the modern business world is research.

So swift and sweeping are the modern developments in industry, so revolutionary are the discoveries of the scientist and engineer that big business does not dare to be without research. I will give you two examples from our own experience.

Phenol Removal Process

All coal-carbonizing plants formerly produced a waste water (ammonia still waste) containing small amounts of phenols which usually found their way, sooner or later, into rivers. This phenol, when diluted with river water is too small in amount to have any effect on health. However, when such water is chlorinated at city waterworks, chlorphenols are formed which have a strong medicinal taste. They taste like the iodoform smells at your dentist's office. This disagreeable taste may cause people to obtain their drinking water from uninspected wells and springs and state health authorities are making a determined stand against the discharge of untreated phenolic wastes into streams which are used for city water supply.

When we were ready recently, to build a plant in a large eastern city, we were not given a municipal permit until we could show satisfactory proof, and guarantee that this plant would not discharge a large amount of phenolic compounds into an adjacent river. A similar situation was facing many other plants. State health departments were refusing to allow coke plants to operate if they discharged these wastes into the streams. Drastic legislation was proposed in Congress. The situation was acute for the builders and operators of by-product coke plants.

Fortunately, we were prepared. As the result of many years of intensive (and I might add expensive) research, we had finally developed a vapor recirculation phenol-removal process, which was already in highly successful operation at our plant at Hamilton, Ohio. We were, therefore, able to satisfy the municipal authorities, the plant started operation on schedule time and results satisfactory to the health authorities have been obtained at all times.

The dephenolizing unit at this plant is a small detail in a great plant, but it is a *most vital detail.* Many other plants are installing this same type of phenol-removal system. This process solves a problem that has been world-wide. The difficulty has been so acute as to cause international complaints on the Rhine between Germany and Holland.

Synthetic Nitrogen

One more example will suffice to show how successful research along new lines may seriously affect some established industry.

Not many years ago, the by-product ovens and gas retorts of the world had a virtual monopoly on the manufacture of nitrogen compounds, that is to say ammonia. In fact it was the need for ammonia that caused the first by-product coke ovens to be built in the United States 37 years ago.

It was the need for ammonia, as well as other coal products, that caused the great development of this industry in the United States during the World War. As the war dragged on, Germany, with ports blockaded, became desperate for nitrogen compounds. Toward the end of the war, the great synthetic ammonia plant at Leuna, near Merseberg, Germany, went into operation. Considering the trying conditions under which this plant was constructed, it is perhaps one of the most ambitious undertakings that the human mind has conceived and completed.

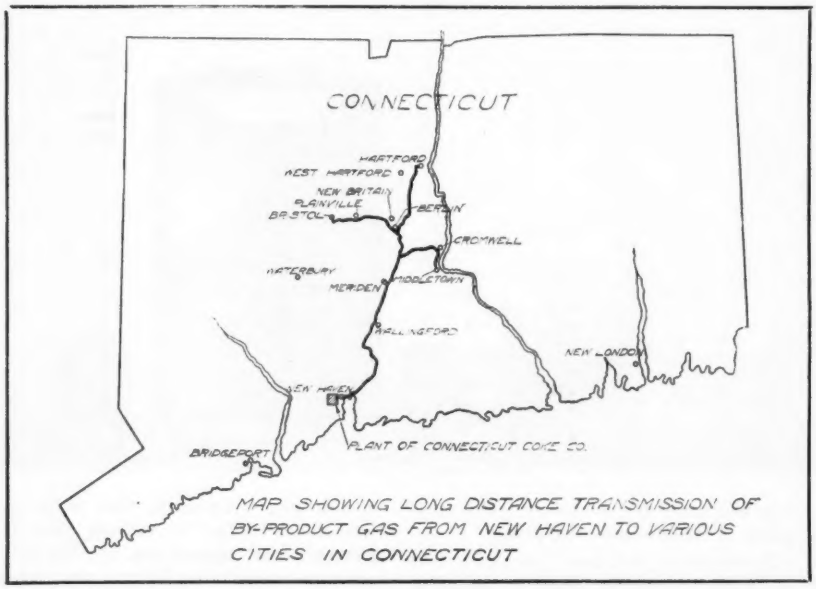
Today this gigantic plant, and its companion plant near Oppau, produce about 600,000 tons of synthetic nitrogen per year in the form of various compounds. This production is said to be nearly twice as great as the total consumption of nitrogen in commercial fertilizers, in the United States.

This nitrogen can be produced cheaply, and after the close of the war it dominated the world nitrogen situation. The prices of ammonia and ammonium sulphate from coke ovens dropped, and have remained at a low level.

Use of sulphur in apple orchard. The unsprayed trees at left are badly defoliated and bear small defective apples. The trees at the right are of the same variety but have been sprayed with flotation sulphur. The foliage is healthy and the trees are well filled with large perfect apples

Ash in Coal and Coke

I am of the opinion that the matter of ash content in coal and coke is just beginning to receive full appreciation. In 1917, the Koppers Company entered the commercial coke field by building, owning and operating the plant of the Seaboard By-Product Coke Company at Jersey City. In 1920, after the demands of the war were over, and things had settled down into quiet routine, this plant began to try to distribute coke into the channels originally contem-



MAP SHOWING LONG DISTANCE TRANSMISSION OF BY-PRODUCT GAS FROM NEW HAVEN TO VARIOUS CITIES IN CONNECTICUT

plated, namely the domestic trade, and for water gas and other industrial uses. The markets were slow to respond and there soon accumulated on the Jersey meadows over 300,000 tons of coke. The reason for the poor response to this coke was *high ash.*

Using the best coals available in the Pennsylvania fields at that time, the coke contained 11/13 per cent ash. When a customer was induced to try coke as a domestic fuel, the results were not sufficiently striking to make him come back for more.

About this time a strike occurred in the bituminous fields and there was such a shortage of coke that the entire 300,000 tons moved out in steam-shovel filled cars to eastern blast-furnace plants. We were saved—and we had learned something.

The Seaboard plant is on tidewater. It was possible to deliver low-ash coals from the southern field by barge from Newport News. We had made up our minds that if coke was to be accepted as a domestic and industrial fuel it must have one outstanding characteristic—*low ash.* Having come to this conclusion, we sought for the lowest ash coals available, and secured a high-volatile coal which contained not to exceed 3½ per cent of ash. A coke made from 70 per cent of this coal with 30 per cent low-ash coal from the New River field has solved our marketing problems. Low-ash coke has proved surprisingly efficient as a fuel for industrial users. However, the greatest results have been achieved in the domestic field. So long as coke containing less than 7 per cent ash goes into domestic bins, we lose few customers.

With this lesson learned, it is significant to note that in our new plants at Philadelphia and New Haven, where low-ash coals were used from the beginning, sales resistance has been absent. Old conservative Philadelphia is demanding a greater quantity of coke than we can furnish, and coke orders go on a waiting list. Domestic coke consumers immediately respond to low-ash coke because of decreased labor and trouble as well as better performance of their heating systems.

Ash in Blast-Furnace Coke

What is the effect of ash in blast-furnace coke? Let us assume that a modern coal-washing plant can economically remove 3 per cent ash from a given coking coal of moderately high ash-content. A 700-ton blast-furnace, operating on high-ash coke, will require daily an amount of coke corresponding to 865 tons of coal. The extra 3 per cent of ash which could be removed by washing, amounts to 29 tons of impurity a day. Fifty-six tons of extra limestone are required to flux the ash, and 42 tons of extra coke are required to melt the extra slag. In addition, overhead charges on coke ovens and blast-furnaces are greatly increased per ton of iron produced.

Without going into detailed calculations, it will suffice to say that a net saving of $315 per day can be shown for a single blast-furnace, by using washed coal. In the above example no credit has been given to the reduction of sulphur which would accompany the reduction in ash. When a good removal of both sulphur and ash are accomplished in coal washing, savings as great as $700 per day, or $1 per ton of iron may be calculated.

The practice of coal cleaning is increasing rapidly at the present time in the United States. It is estimated that last year well over 30,000,000 tons of bituminous coal were cleaned. About 15 per cent of all coal coked in by-product coke ovens is first washed, and this percentage is on the increase. Highly efficient coal driers are now in use at washing plants, and permit the delivery of washed coal containing only about 4 percent moisture.

A few minutes ago I told how we had to stop using Pennsylvania coals at our Seaboard plant. It is gratifying to note that the two largest coal-washing plants in the world are now located in Pennsylvania, and are producing coal for coking purposes.

Unloading low-ash coals from southern West Virginia. At plant of the Philadelphia Coke Company

Domestic Coke Merchandising

Domestic coke is a distinct type of coke, *made to specifications,* from selected coals, in order to produce the best possible fuel for the domestic trade. Not many years ago there was little coke offered as household fuel which could meet the above requirements.

Much of the coke offered was not domestic coke (in the proper sense) at all. It was the *rejects* or small sizes from metallurgical coke. At some plants such rejects were, and today still are, good domestic fuel. But far too often, such products are high in ash, have a low ash-fusing temperature and are poorly sized. All of these factors combine to cause clinker trouble and other complaints. Coke from gas retorts is another variety which usually failed to raise coke in the (*Continued on page* 76)

MODERN MINE MANAGEMENT

Underlying factors of modern management are organization, forecasting, planning and definitely controlled execution of pre-determined plans—Tradition versus progress

By ERNEST L. BAILEY *

AS A RULE the responsible executives of mining enterprises have been slow to adopt, either in whole or in modified form, the principles of management and administration which have proved so enormously profitable in the manufacturing field.

The reluctance of mining executives to modify their management technique or change to a different type of administration has been predicated, in part, on sound reasons. Some of the problems met with in mine operation are basically and fundamentally different from those encountered in factory operation, and, to that degree, require a different production concept.

The factory deals with a raw or semi-finished material, producing a standardized product under standardized conditions. Its capacity, rate of production and unit costs are susceptible of virtually accurate pre-determination. Each separate operation may be carefully planned and timed and the workman becomes highly proficient through the constant repetition of the same task in the same way.

The mine, on the other hand, is engaged in the extraction from earth of a natural resource under widely varying conditions of seam, roof, pitch, drainage and gas liberation. It challenges the utmost ingenuity, initiative, courage and resourcefulness of every man connected with it from the miner at the face to the chief executive officer. The blasting of each new face holds the possibility of revealing a changed condition which will call for a change of methods. Each gangway or entry is traversing a path over which, at best, conditions can be only partially known in advance of development.

It is believed that no system of management, however scientifically devised, can replace in mining, to the same degree that is possible in factory operation, those personal qualities of leadership, courage and character which are the essential attributes of a successful mine operator.

Up to a certain point of departure, however, the management problems of the mine and factory are similar and the management technique of the factories can, with necessary modifications, be profitably applied to the operation of a mine.

At this time mine mechanization appears to be on the threshold of an almost revolutionary development. It will not advance as rapidly as many hope for or anticipate. Grave economic obstacles will retard its progress and many knotty problems still await the solution of mining and mechanical engineers, but while its course may be temporarily impeded its continued advance is certain and inevitable.

As mine mechanization progresses, the management problems of mine and factory become more kindred in character and the mining industry will find it increasingly necessary to develop and adopt a management technique based on sound scientific principles.

Ernest L. Bailey

The principles briefly set forth in this article are not new or untried. They have successfully met the test of application to actual mine operations with extremely gratifying results, and are the foundations on which the established practices of many successful companies are primarily based.

FUNDAMENTAL FACTORS

The four fundamental factors underlying mine production are (1) Natural Conditions, (2) Labor, (3) Capital, (4) Management. It is the function of management to unite the first three factors into a well balanced, properly coordinated, smooth working mechanism which will produce the greatest ultimate profit for the least capital expenditure.

As no mining enterprise enjoys a complete monopoly on either markets or natural resources the success of the enterprise, broadly speaking, is entirely dependent on the management as management is presumed to control every act or commitment of the enterprise, including the selection of the property to be exploited.

In essence, modern management is nothing more nor less than the intelligent and definitely controlled execution of a carefully thought-out plan of business administration which is in harmony with natural economic laws and based on adequate information after all pertinent facts have been developed.

In this sense, divorced from the highly developed factory technique which in the public mind has become almost inseparably attached to the term, it can be applied to mining with amazingly profitable results.

The underlying factors of modern management are (1) Organization, (2) Forecasting, (3) Planning, (4) Definitely controlled execution of pre-determined plans. Each factor is basic and must be properly coordinated with every other factor and as the conditions in mining are subject to wide and sudden fluctuations extreme care must be exercised in adoption of methods and in setting up the administrative machinery to see that sufficient flexibility is retained to permit of quick adjustment to changed conditions without disturbing established

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procedure or violating fundamental principles.

Organization

Organizing the personnel of a mine presents many problems not encountered in the manufacturing industries. In the factory ways and methods are fully determined by the planning department and the ability of the workman to quickly adopt the material at hand to the requirements of the occasion is not called for. Initiative on the part of the workman is, therefore, neither encouraged nor desired. The most efficient workman being the one who, by reason of purely physical ability, becomes the most adept in the performance of his simplified and standardized task. Mining, by reason of the inherently different and highly hazardous conditions under which it must be carried on is not susceptible of the complete standardization of either methods or performance and consequently, the initiative and resourcefulness of each employe must be encouraged and developed along sound lines to the end that the employer may profit from the exercise of these qualities while at the same time preserving the principles of established practice except as and when officially changed.

The most efficient type of mine organization is one which, while maintaining a definite control over quality of product, character of workmanship and performance quotas, still permits the widest possible latitude for constructive thought and action on the part of the workmen and subordinate officials.

The traditional and usual mine organization is built on the straight line type. That is responsibility and authority passes on a straight line down from the executive head to the general manager, superintendents, foremen and so on down the line to the workmen. Each man being responsible to his immediate superior for the quantity and quality of work performed.

This type of organization admittedly has its strong points. It permits of ready placement of responsibility and reflects, perhaps more accurately than any other type, results accomplished by individual effort.

It pre-supposes on the part of each man holding a position of responsibility, an intimate familiarity with every phase of the work under his charge and the ability to direct and supervise it in the most efficient manner, devising methods of performance and judging accomplishment and workmanship only by the knowledge gained from experience without the aid of approved standards or the definite records of previous performance.

This type of organization probably served the industry well until the advent of mechanization which, despite the comparatively recent coinage of the term, really began with the installation of power and power-driven equipment. As mechanization has progressed and ushered in new and more complex problems, the straight line type of organization has developed increasing weaknesses of which the absence of a definite standard of workmanship has perhaps been the most glaringly apparent.

A simple case in point, but one likely to strike home to most readers, is mine haulage track. Practically every mine operator, superintendent or foreman takes considerable pride in his haulage track, yet in visiting a number of mines, even in the same locality, one can not but be struck with the wide differences which exist in installation and maintenance. The reason for this being that the track in different mines and frequently in different sections of the same mine represents different individual views as to what, under given conditions, constitutes correct haulage track; although fundamentally their haulage conditions may be identical.

This type of organization leaves too many important details and decisions to the judgment of the workmen and subordinate officials and too little control to the management. Management, to function properly, must control not only the major policies of the enterprise but the more important details as well and this must be accomplished with the least possible expenditure of time and effort.

This can best be done by the formulation and adoption of written standard-practice instructions or methods—bulletins which will, in so far as possible, prescribe the precise manner in which the work is to be done rather than leave it to the judgment of the individual workman or the man who is bossing the job. Authoritative and generally accepted standards covering several phases of mine operation are now available through the American Mining Congress and these should be conformed to in the preparation of individual company standards in so far as mine conditions permit, however, each company will find it advisable to prepare its own standards and methods bulletins to meet its particular conditions. This is especially true of rules governing safety, blasting and preparation.

In seeking for a type of organization which will eliminate the defects inherent in the straight line type the staff and line presents the logical solution as it retains most of the good features of the former type, supplementing the knowledge and skill of the operating officials with the specialized training of the staff members without serious infringement of authority or responsibility for performance.

Many mining companies have already adopted this type of organization with gratifying results. The actual set-up of the organization, with varying numbers of personnel, invested with varying degrees of authority and responsibility, will work out differently for different companies and will depend largely upon the size, output, conditions and specialized problems of the mine or mines which the staff is to serve. It goes without saying that care must be exercised to know that each staff member is actually a specialist in his particular line and can give definite, correct and authoritative advice on matters coming under his jurisdiction. It is also important to hold the staff personnel to the minimum number adequate to the requirements of the company in order that costs may not be unnecessarily burdened with non-productive salaries.

With the adoption of a staff and line organization by a mining company there enters the difficult problem of coordinating the various activities of the staff members and operating officials. This is a recurring problem which must be dealt with by the operating head and the skill with which it is handled determines in a large measure the efficiency of his organization.

A few attempts have been made to apply to mining enterprises the purely functional type of organization but none of these have, to the writer's knowledge, attained even a small measure of success for the reason that, particularly in mining, responsibility can not be successfully divorced from authority.

Forecasting

The word forecasting has been properly used in engineering literature to describe the complete planning of all details of a mine from the beginning of development to the exhaustion of the property; a task holding infinite possibilities and worthy of more thought than it ordinarily receives.

As used in this article, however, the word will be used in its generally accepted sense in connection with sales, markets, trends and new developments.

No enterprise can intelligently plan an economical production schedule and control the investment of capital and employment of labor without having at least an approximate idea of the quantity of its product it will be able to sell over a given period and the price it will bring.

The total ultimate sale of any commodity depends, in the final analysis, on the capacity of consumers to purchase and utilize it. Forecasting of sales, therefore, involves as a fundamental step the study of markets and the gauging of consumer demand. Many branches of the mining industry have developed the art of forecasting sales, over comparatively long periods, with remarkable accuracy. In the branches which have been most successful in this direction the problem has been complicated by the fact

that a world market rather than a domestic market must be considered.

The branch of mining which faces the most difficult problem and consequently has made the least progress in sales forecasting is the bituminous coal industry; but even in this branch certain commercial companies, possessing no particular advantage in sources of information over their competitors, are able to forecast their production demands with reasonable accuracy at least three months in advance.

Forecasting is essentially an effort to look into the future and estimate, in the light of all obtainable knowledge as to market conditions, the amount of product which can be sold, the purpose for which it will be used, the form in which it will be wanted and the price it will bring.

In this connection past experience, properly correlated and analyzed is of most helpful assistance, but if forecasting is to be lifted out of the realm of guesswork and placed on a reasonably dependable scientific basis it must be somewhat independent of history and tradition.

Sticking to bituminous coal as an illustration, everyone who has been in the business as long as 20 years is cognizant of the many sweeping changes which have occurred in that period.

Twenty years ago it was practical to assume that we as a nation would consume from 5 to 10 percent more coal in the current year than we did in the previous one and that the succeeding year would show a similar increase.

For the most part, coal was either sold as run of mine or separated by bar screens in the tipple into lump and slack. If a customer had the temerity to complain of excessive ash the salesman tactfully but firmly explained to him that Providence, in its wisdom, inserted that ingredient and that it was little short of sacrilege to criticize it. Not only nothing could or would be done about it, but in view of its divine origin, nothing should be done about it.

Since those days science and research have set a fast and accelerated pace. Coal is now a merchandized product, sold on specification or analysis, carefully cleaned and sized to meet the needs of a critically exacting market, selected with painstaking care by the users to satisfy the peculiar demands of a particular plant or industry.

This change in the use of coal is still going forward and the end is not yet in sight. Coal producers who can forecast with greatest accuracy the trend in the future use of coal, and lay their plans accordingly, will enjoy a distinct advantage over their competitors who are content to follow in the wake of new practices after they have become firmly established.

The mechanics of sales forecasting are not necessarily complex. It is assumed that any mining company will attempt to move its products only to their natural economic markets and that it will establish a definite and soundly competitive sales policy, with full sales coverage, for each district or zone of distribution.

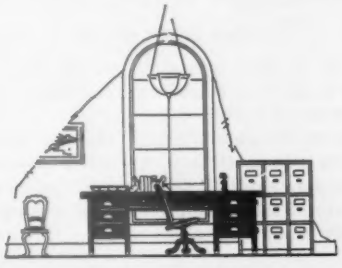
It is then desirable to ascertain the history of consumption in the district by months, if possible for a period of years, and to examine any factors which may influence or change future consumption. The sales executive and the district manager, guided by previous experience if a record of such is available, will then attempt to determine what share of the total business of a given period they can reasonably expect to get and at what price. This figure will become the sales forecast and sales quota for the particular district, and should be kept up to date by monthly revision.

Care must be exercised in setting this figure that it is not beyond probable attainment with diligent and intelligent effort on the part of the district sales manager and his organization.

From a psychological viewpoint, it is better for them to slightly exceed rather than fail to make their quotas; also, as this quota, combined with similar quotas from all other districts, becomes the sales forecast of the company on which the production schedule must be planned it is desirable that it be conservative, as it is usually far easier and less expensive to raise production over an estimated minimum than to lower it below one.

When a system of sales forecasting and quota assignment is first inaugurated it should not be expected to work perfectly. Like most new mechanisms it is likely to have certain "bugs" in it which only time, patience and perseverance will work out. Not the least of these will be the reluctance of the district managers and individual salesmen to assume definite responsibility for producing a given volume of business in a specified time.

Forecasting sales with dependable accuracy is admittedly a difficult lesson to learn, but the difficulties are not insurmountable and it is being done, even in the bituminous coal industry, and the profit derived from the opportunity it affords to plan a production schedule to take care of a minimum tonnage and price figure pays a golden yield on the effort expended.



The planning of mine production to meet a given tonnage schedule involves consideration of capacity, adequacy of equipment, present and future mine development and costs.

Planning the Production Schedule

The subject is too well understood by the mine operating personnel to justify an extended discussion even if space permitted. It is desirable, however, to touch on one phase of production planning which is essential to intelligent cost control and which has not generally received the attention it merits. That is the estimating of the number of employes, or better still man-hours, which will be necessary to produce a given tonnage, in what departments or mine sections they will be required and how they will be divided as to classifications and rates of payment.

Estimating the required number of tonnage men, or men employed on a contract or piece-work basis presents, in most instances, no particular difficulty and the control of this number, except during periods of labor shortage, is relatively less important and more easily accomplished than estimating and controlling the required number of day wage or company employes.

After the estimate has been made control can be greatly facilitated by the daily compilation on prepared forms of a "Labor Quota and Force Report" which will show for each department or mine section: (a) estimated number of employes or man-hours required, (b) expected tonnage, (c) estimated unit cost, (d) actual number of employes or man-hours used, (e) tonnage obtained, (f) actual unit cost, and (g) brief explanation of extraordinary work or abnormal conditions.

It might appear that in an industry so widely varied and subject to changed conditions as mining such an estimate and report would be valueless. Experience has shown, however, that if the estimates are carefully made, and control intelligently exercised, actual results will conform to projected results with remarkable accuracy and that substantial savings may be effected by its use.

Budgetary Control

Modern management requires, as an indispensable adjunct, intelligent budgeting; as that is the only instrument through which it can exercise control of the business. Most, if not all, of the larger mining companies now prepare some sort of budget of financial operations which forecast, with varying degrees of accuracy, expected income, estimated expenditures and net results over a six months or yearly period.

The construction and use of a financial budget is too well known by mining executives to merit a lengthy discussion here, except to say that the budget must be built especially for the particular business and organization it is intended to serve. Many budgets have been disappointing and ineffective in the results obtained, not because of any inherent defects in the construction of the budget itself or of lack of diligence on the part of the management in attempting to control the expenses the budget was planned to govern, but because the executive who inaugurated it was like a carpenter who carefully attempted to build a house before laying the foundation.

A budget compiled without the aids of a painstaking sales forecast and a carefully planned production schedule, including unit costs which take into consideration all necessary or projected items of expense or probable changes in conditions which it is possible to foresee, is necessarily a combination of history and guesswork and is relatively valueless.

If the item of guesswork were eliminated and history could be relied on to currently repeat itself, such a budget would be perfect. Despite a widespread belief to the contrary, however, history never precisely repeats itself.

If a reasonable amount of care and skill is employed in preparing the sales forecast and production schedule the resulting budget will contain the best thought and set a mark for the best accomplishment of the entire organization with a prior commitment or implied obligation to successfully carry out its provisions.

In the hands of a skillful executive it becomes an instrument of almost perfect control. Its function is just as important and its value as far reaching in a mining, as in a manufacturing enterprise, but this value can be developed and translated in profitable results only by the executive in charge, for the control of the budget demands the authority the responsibility implies and it can not be successfully delegated to a subordinate.

Conclusion

An attempt has here been made to condense into the brief space of a magazine article, a description of a few of the tools of modern management and a statement of their uses. The writer is keenly conscious of the inadequacy of the result, but if the mine operator or executive who has read in the trend of the times the passing of the old order has been helped to a somewhat clearer understanding of the direction the new order is taking the effort will have been worthwhile.

We, of the mining fraternity, have been somewhat too prone to inquire in loud and strident voices "what is the matter with the industry?" thus advertising to our customers and to the world at large our lack of faith in or control over our own business. This is a situation which no individual can correct, but which each can correct to some extent by definitely pursuing a planned course of action in keeping with the best interests of the industry and with the best ultimate interests of his particular company.

Economic conditions will change in the future as they have in the past and the mining industry will continue to be in a constant state of flux in its effort at self adjustment. In the realization of this continuous adjustment, the established principles of modern management can be infinitely helpful.

The problems of the mine and the factory differ largely in that the former must cope with the forces of nature in the winning of its product. Still the engineering principles governing the control of these forces were worked out and established long before "mass-production" was ever heard of.

We may, perhaps, be unfortunate by reason of the very antiquity of the industry. We may be more influenced by tradition than we realize or care to admit. Would it not be a good idea to put a ban on the remark, so frequently made with evident pride around mines, "we have always done it this way."

BY-PRODUCT GAS AND COKE INDUSTRY

(*From page 72*)

public estimation.

There are still many localities in which it is difficult to buy genuine domestic coke, that is, a high-grade coke, made to specification for the domestic trade. Fortunately it is being made and sold in continually increasing quantities.

However, it is not enough to manufacture a high-grade product—it must be sold. The aggressive handling of sales and distribution problems is just as characteristic of our modern age as is research.

At each of our plants a coke sales department is maintained, and users are furnished with competent technical service. Time is not available to describe merchandising methods and policies, and it must suffice to say that we keep the value and quality of domestic coke before the public at all times, and make sure that each user obtains the size of coke that meets his requirements.

Gas Distribution

It is very generally considered that in no field of public utility is there such great possibility for expansion as lies before the gas industry. Heating homes with gas, automatic hot-water heating, gas refrigeration and air conditioning are some of the developments that will cause this expansion.

As the use of gas for refrigeration, and for cooling and conditioning the air in homes, increases, the improvement in load factor is going to be such that gas rates can be lowered and still greater use of gas be made possible.

All of this brings me to the point that the whole development of the gas industry rests on the successful automatic operation of appliances. For automatic regulation, gas should not only be of unvarying heating value and specific gravity, but must be free from the impurities which would cause stoppages in mains, meters, service lines and pilot lights. This result is achieved by the various purification processes which have been developed by our research laboratories.

There is one more development that I wish to call to your attention, and that is the long-distance transmission of manufactured gas. This subject is rapidly growing in importance, both in Europe and America, but I shall give you only one example.

From our New Haven plant have been built pipe lines supplying gas over a wide area—in fact 65 per cent of the gas produced in the state of Connecticut is made in this plant.

Coke is delivered in New Haven by trucks and is shipped in railroad cars to other points in New England.

Value of Research in the Coal Industry

Last year, in a radio address delivered at the opening of the Second International Conference on Bituminous Coal, I said: "Among the great industries of the world, the Bituminous Coal Industry stands foremost in stagnation."

Coal men have been asking in recent years, "Does research pay?" Your Board of Directors suggested that this paper contain a prophecy as to the future of the coal industry. Is that necessary, or do the facts that have just been presented speak for themselves?

WORLD PRODUCTION OF MICA

The annual world output of sheet mica has grown in three decades from 1,250 short tons to more than 10,000 tons, according to the Bureau of Mines, which has conducted an economic study of the subject.

New Hampshire and North Carolina are the chief producing states in this country. Normally fully one-half of the American output of sheet mica has come from New Hampshire and more than one-third from North Carolina.

This report (Information Circular 6205) contains details regarding the occurrence, chemical composition, and uses of mica, mining and manufacturing methods, grades and specifications, etc.

The ALABAMA COAL INDUSTRY in 1929

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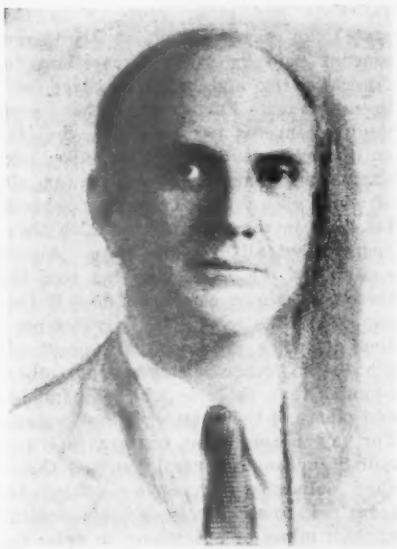
Railroads, cotton factories, cement plants and paper mills aid coal industry—Work of safeguarding miners and families outstanding—Accidents reduced 50 percent in two years—Mechanization of mines helpful—Coal is foundation in modernizing the state—Industrial workers and plants a market for products of farm

By JAS. L. DAVIDSON *

A REVIEW of the coal industry for the past year will likely prove lethargic and devoid of thrills to the reading public. Whereas to those engaged in the industry it has been a similar struggle to that of the previous 12 months and more, to meet the heavy competition in our natural trade territory from hydro-electricity, natural gas, and fuel oil, also to keep the mines going during the depressed condition of the market. One of the principal factors that has kept the people employed by the mines producing steam coal in Alabama from going hungry was that a large portion of the product was taken by the railroads serving the Alabama coal mines, and likewise that a number of cotton factories and all of the cement plants and paper mills have continued to use coal for heating and making power to the extent of their requirements. We are informed that these concerns have found coal more dependable, satisfactory and economical than purchased power or other forms of fuel.

Although the realization per unit of production was less in 1927, 1928, and 1929, than in the previous year, because of falling off in demand, and the gross receipts of the operators as well as the miners was several million dollars less than in 1926, the operators by instituting improved mining methods as a means of reducing the cost of mining, assembling and handling the output and in cleaning the coal, and through efficient salesmanship, were able to market a few more thousand tons of coal in 1929 than in the previous year. But this increase in production is hardly appreciable when compared with the increased expenditures of the coal operators in an endeavor to protect the workmen in and about the mines against personal injury and also to maintain good health and comfortable living accommodations for their employes as well as to give them training in hygiene and first-aid to the injured.

Since 1927, the fatalities from falls of roof and coal—the most prolific source of all mine accidents—have been reduced over 50 percent. The use of permissible explosives and closed lights has been increased. (There being now employed and used in 45 coal mines of the state 7,842 electric safety lamps.) The ventilation of the mines has been materially improved to the extent that there have been only two gas explosions since July, 1926. In the number of mines and the mileage of mine workings covered, Alabama stands among the first in the use of rock dust for the prevention of coal dust explosions; wherefore, during the last three years there have been no explosions of coal dust resulting in loss of life in the coal mines of Alabama. The employment of safety engineers, inspectors and section foremen, and general education in accident prevention conducted by the mine operators, the Alabama Mining Institute, State Mine Inspection Department, and the United States Bureau of Mines, has also been materially responsible for the keeping down of accident frequency among the coal mine employes.



James L. Davidson

Practically all of the mines in the district that employ electricity for driving fans have an auxiliary drive on the ventilation fan for use in case of emergency. Many of these have been installed at heavy expense during the past year. Also several of the large mines have put in new fans, remodeled ventilating systems, and taken other measures to insure the safety of their workmen. The sale by the coal mining commissaries, at practically cost, of heavy rubber-soled and rubber-vamped working shoes, to the workmen employed around electrical apparatus and bare wires charged with electricity, as a means of lessening the dangers from electric shock; is one of the innovations recently introduced calculated to cut down the accident frequency from electric shock.

It has been truthfully said that the foundation of the industrial structure of the nation stands on coal; and in searching the annals of human events and achievements, the feature that stands out most prominently is that the progress of modern civilization in every country on the globe has centered around the coal fields; culture, civic consciousness, constitutional government, commerce, art, science, literature, as well as growth morally, materially and financially, have advanced proportionately with the development of the coal industry in each case. On the other hand, the nations which have no coal or where the coal business has been hampered or neglected, have stood still, and atrophy in all of the above is apparent and no progress is evidenced.

Therefore, it is relieving to note, that the political pagans (who have heretofore sought by ill considered and vicious legislation to cure the ailments of the industry by prescribing a counter irritant rather than applying the soothing and healing lotion of non-interference) have diverted their attention to "Paid Lobbyists" and "Prohibition."

Let us then consider the results from the development of the coal industry in

* Secretary, Alabama Mining Institute.

Excerpt from

TRANSACTIONS OF THE MEDICAL ASSOCIATION

of the

STATE OF ALABAMA

1929

Committee on First Aid

J. D. Heacock, Chairman

The First Aid movement in Alabama is under the auspices of the Alabama Mining Institute, U. S. Bureau of Mines, Holmes Safety Association, American Red Cross, State Mine Inspection Department:

The appointment of a committee of doctors from the State Medical Association, was inspired, I presume, from a realization of the fact that accidents and acute illness are interrelated, and involve a phase of industrial hygiene that naturally falls within the province of the medical profession.

I happened to be appointed Chairman of this first committee, and with our president, Dr. Caldwell, attended the 10th Alabama First Aid contest. It was a more or less thrilling, and very gratifying exhibition, and good evidence of much wholesome training. No one could help being impressed with the fact that first aid and prevention is a more valuable economic proposition than is the process of rehabilitation.

The comprehensiveness of this very worthy project can but be appreciated when we consider that it involves health and man power, as well as casualties.

It is reported that one of the largest companies in Walker County made a comparison of accidents among trained men, versus untrained, and found that the time lost by the latter was eight times greater than among the men who had received first aid training.

The virtue and achievements of the work are quite creditable and as was very graphically expressed in a message from the governor to the Chief Mine Inspector, when he said, "Keep on going on."

Too much credit can not be given to Mr. Jas. L. Davidson, Secretary of Alabama Mining Institute, and his assistant, Mr. H. E. Mills, for the praiseworthy and humanitarian effort.

the Birmingham District and what it means to the people of Alabama and nearby states.

The coal fields of Alabama, according to best authorities, cover approximately 8,000 square miles in the counties of Bibb, Blount, Etowah, Fayette, Jefferson, Marion, St. Clair, Shelby, Walker, and Winston; and contain more than ninety billion tons of recoverable coal.

Since coal mining began in Alabama only about a half of a billion tons of coal have been mined. Even so, there has been phenomenal development in all lines to the extent that eight principal coal producing counties yield 81 percent of the entire ad valorem taxes paid by all classes of property owners in the state.

Without coal mining, this development and enhancement in property valuation would not have taken place. For without coal, the ores and raw materials could not be economically turned into merchantable products, or locomotives operated to haul them to market, or the power produced to turn the wheels of industry; and without coal, Alabama would not stand fourth in the production of by-products derived from turning the coal into coke; and without coal, there would be no nearby markets for the products of the forests and farms of the state; and without coal, there would be no economical and convenient way during cold weather of heating the homes and other buildings where men, women and children are sheltered.

The coal mining industry within itself means much more than the above to the people of Alabama. These coal producing concerns pay one-tenth of the entire ad valorem taxes paid by all classes of property owners in the state (including the power companies, public utilities, railroads and other property in the state), to say nothing of the large amount paid by these corporations in franchise tax and other privilege and license taxes. Furthermore, these coal mining concerns pay, including the tax on iron ore, around a million dollars per annum in tonnage and severance tax, all of which goes for the support of schools not only in the counties in which they operate, but all over the state. About one-half of the ad valorem tax paid by these coal mining companies goes to the support of the schools, the greater portion of which goes to the support of schools in other districts and other counties than those in which the mines and plants of these concerns are located. For this reason these concerns are required to donate several hundred thousand dollars per year in addition to taxes paid to support the schools located at their mines or operations, in order to have full school terms at these places. This amount does not include the donations made by the individual coal mine employes of these concerns toward the support of the schools. Furthermore, the coal producing concerns in the state have built and equipped at their own expense adequate and modern school buildings, entailing investment of more than a million dollars, which are and have been for years furnished rent free for use by the state and county educational departments for school purposes.

One of the greatest contributions to the welfare of the people of the state that has been made, and is now being made by the coal mining concerns of the state is what they have done, and are now doing, to prevent diseases among them and maintain the good health of the mine workers and their families. This work was started in 1910 and has reached such proportions that typhoid fever has practically been eliminated and malaria is no longer a problem, and whenever communicable diseases are brought into the mine villages from outside sources, they are promptly suppressed. The methods and means adopted by the coal mining concerns in sanitation and prevention of disease were taken up and adopted by the public health authorities of the state to the extent that there has been the most wonderful result obtained all over the state to make the people of Alabama exceptionally healthful; and thus to eliminate the great loss that wage earners and other citizens of the state were theretofore suffering from the ravages of disease.

The coal mining industry has been the greatest instrumentality of all forces operating toward that end to raise the standard of living among the working people in the section of the state where their mines, mills and plants are located. This example and influence has been reflected to other industries and to other localities in Alabama to the general benefit of all the people living within its borders.

Normally, the coal mines of Alabama provide around seven million man days working for 30,000 employes, and provide nearly forty million dollars per year payroll. This is spent by these wage earners and salaried employes for merchandise, transportation, amusement, insurance and the like; or is invested in real estate and securities or deposited in the savings bank. To put it another way, 70 cents out of every dollar received by the coal operator for coal goes to labor and this is spent as above noted. A goodly portion of this goes to purchase farm produce and products of the soil. Consequently, the coal mine concerns in the Birmingham district are buying to feed (*Continued on page* 87)

Progress Made in ILLINOIS Coal Industry

By JOSEPH D. ZOOK *

Optomistic attitude prevails throughout Illinois coal industry—Centralization of activities and cooperation great factors in upward trend—New and modern step expected to lead to stabilization of industry—Mechanization progressing with 42 mines fully mechanized and 18 additional partly equipped—Labor problems being solved by new attitude of operators and workers.

ALTHOUGH the Illinois coal industry has suffered severely in recent years—as have most other coal producing districts generally—there are now positive signs here of an improvement that is more than superficial. Less than two years ago, leading operators in this field decided to take steps which it was hoped would relieve the industry of some of the troubles that were withholding the making of a fair net profit for the average operator and providing more regular employment for the miners.

With a minimum of publicity, the task of relieving the industry of obviously hampering factors was undertaken, with a determination to strike, if possible, at the very roots of the problem. The condition of the industry in Illinois has been unsatisfactory for some years; and naturally, a great deal of thought has been given to various elements, and in order to find solution, a number of methods have been studiously considered. Some really fundamental thinking had been done in the direction of determining the exact nature of ills affecting the industry, the basic cause of these ills, and the possible remedies that promise sound and lasting benefits to all concerned. The real task of the diagnosis was to avoid mistaking merely a "symptom" for a fundamental cause, and prescribing for the "cause" instead of a mere manifestation.

We had, of course, certain elements to deal with which could not be changed; they were what might be termed "constant factors"; we had the physical properties themselves; we had coal with characteristics which had a bearing on both production and merchandising problems; we had competition from other fields; we had the problem of securing for our employes the highest possible annual earnings; and finally we had an elusive or unknown "x," or at least a rather fluidic factor to deal with in what we call "human nature," which is ordinarily based on tradition, prejudices, and indifference, and can only be changed by long and steadily maintained demonstration and education along new lines.

As a first step the coal producers in Illinois eliminated a number of independent and unrelated activities through assembly and correlation of all essential service and informative agencies in one group, occupying a suite of offices in one building in Chicago, thus guaranteeing through centralization and cooperation, in a general council of all previous activities, appropriate facilities for providing closely current attention to any and every matter of interest or concern of every department of the coal industry in the state, such as labor in all of its ramifications, freight and traffic matters, accumulation of statistical data having to do with commercial aspects, mine operations, service of railroads and production at the mines, the distribution of coal, its sale and application, as well as credits, publicity and the maintenance of appropriate public relations.

This new arrangement has now continued for something over a year and has already demonstrated that far more satisfactory and careful attention can be given to a wide variety of subjects, many of which are more or less complex, and can only be handled on the basis of full, prompt and complete information on every aspect of a given problem, together with intelligent administration.

Such a set-up is particularly valuable in connection with relationship to our mine labor. If we are to make collective bargaining successful in this state which employs at this time 60 to 70 percent of the total number of dues paying members of the United Mine Workers of America in the bituminous fields (figures taken from "Illinois Miner" of January 11, 1930), the continuity of our study and day to day determination of every question that confronts us under such peculiar circumstances, constituting as it does so sharp a reversal of conditions prevailing only a very few years back, it is felt by the Illinois producers that they must have constantly available absolutely dependable fact data covering every aspect of their activities.

It is this writer's belief that, as the outgrowth of a peculiar set of circumstances, to the coal producers and miners of Illinois has been automatically delegated in a manner and to a degree which has never before confronted the operators and miners of any other single state, the task of proving or disproving certain outstanding economic and practical factors having to do with mine ownership, mine employment and the public interest.

It is a new but modern step which it is our hope may lead to a stabilization of the industry in our state and possibly be found worthy of adoption elsewhere.

As director of the Illinois Coal Operators' Labor Association, the writer feels warranted in expecting outstanding results although admittedly it will take time and may move slowly, due to the fact that our dealings are entirely with human elements with an ever present difference of viewpoint, method of procedure and ultimate aspiration.

The expressed purposes and objects of our association are "to promote stable, just, harmonious and businesslike relations between the coal operators of Illinois and their employes; to secure in labor contracts a recognition of the legitimate needs and rights of the employes; to aid in enforcing contracts between the coal operators of Illinois and their employes; to promote businesslike methods of negotiating contracts and in operating under them; to provide means for the interpretation of labor contracts,

* President and Commissioner, Illinois Coal Operators' Labor Association.

and, in general, to promote in all lawful ways the interests of the coal operators of the state of Illinois."

A little more than a year ago, our operators made a three and one-half year wage contract with their employes. Every precaution was made to provide justice to both parties. We believed then, and our experience has justified the belief, that a "fair contract is easily enforced." Operators and miners alike wanted peace, and regular and uninterrupted mine operation, to meet the ever increasing competition from other fields.

Striking miners are being more universally penalized and compensation for time lost through alleged fault of management is being rapidly eliminated and is allowed only in cases where such payment is clearly just and warranted under the provisions of our wage agreement.

Provision is made for the independent arbitration of any disputes, arising under the wage contract, which can not be otherwise satisfactorily settled. This provision recognizes the fundamental community of interest between the two contracting parties, and, in the writer's judgment, simplifies the handling of wage disputes to a great extent, and especially when this fact is clearly understood by both sides to a controversy. It is the recognition and understanding of this fact that makes independent arbitration an entirely proper as well as a constructive step forward.

Not only is it fair, but, as it has worked out with our association, is the profitable arrangement for all concerned. The very fact that the provision is there—that the contract is believed to conserve the interests of all equally—actually works against the tendency on the part of either side to hold to positions where outside arbitration becomes necessary. On July 1, 1929, William B. Wilson, Secretary of Labor for eight years in President Wilson's cabinet, by joint action of operators and miners in Illinois, was selected as arbitrator in all disputes which have failed of settlement. National significance was attached to this step; and recent action of employers and employes of other business interests in adopting this plan, shows that observers recognize its helpful influence and value.

Our people have had experience enough with this procedure to warrant the statement it is doing all that was expected. For the first time in several years we have, over a considerable period now, had an increasing spirit of good feeling generally between our operators and miners. What little trouble we have had, has been clearly from the "bolshevik" element, which element is strongly opposed by the rank and file of the men employed, as demonstrated so clearly during the latter weeks of 1929.

Considerable progress has been made in the mechanization of our mines. Forty-two (42) mines in this state have been fully mechanized and eighteen (18) others are now partially equipped. In recent months, approximately 43 percent of the output was produced by mechanical devices.

It is gratifying that the introduction of machinery into the mines of Illinois has decreased the accident hazard materially and as the men become more accustomed to using these machines, the showing will be even better.

The total production of coal in Illinois for 1929 was approximately 58,000,000 tons as compared to 54,000,000 tons in 1928, or an increase of approximately 8 percent, whereas the increase for the country as a whole was approximately 5 percent.

While all problems have not been solved, we believe we are on the way towards their solution, and we are devoting our best energy to devise ways and means to this end. The coal operators of Illinois are optimists as to the future.

1929 SETS RECORD IN ELECTRICAL BUSINESS

The volume and the dollar value of electric equipment produced in 1929 were greatly in excess of the maximum record of any former year, according to John Liston, of the General Electric Company. This, he explains, was the result of the increased activities in industry, transportation and communication.

The pragmatic worth of research was graphically indicated by the fact that more than 20 percent of the total income received was for electric apparatus which as recently as a decade ago was either unknown or of negligible importance commercially.

Two record size turbine generators were completed and placed in service: a 208,000-kilowatt, cross-compound unit, and a 160,000-kilowatt, tandem-compound unit, each the largest of its type so far constructed. Of exceptional interest because of its potential influence on the future of central station practice and possible economies, was the growth in the use of turbines operating at steam pressures of 1,200 pounds, the aggregate capacity of such machines completed or under construction being greater than the combined capacities of the preceding six years.

A third large passenger ship, with electric propulsion, named *Pennsylvania*, was completed for the Panama-Pacific route, and work on similar propelling equipment for coastwise and transoceanic liners was in progress at the close of the year.

The electrification of railways proceeded at an unprecedented rate, and new records were achieved in the number of electric and oil-electric locomotives built. The gasoline-electric type of railway car was provided with increased power, while the tendencies in street railway operation were generally along the lines of lighter construction and the use of improved forms of electro-pneumatic and magnetic braking in order to maintain adequate schedules despite the growing density of urban traffic.

With more than 10,000 miles of airways and about 260 intermediate landing fields provided with guide beacons and ground lighting, the United States Department of Commerce was enabled to decide on practical standards for airway and airport lighting systems. It is expected that more than 2,000 miles of additional airways will utilize this standardized equipment, Mr. Liston says.

FELDSPAR CLASSIFICATIONS

A tentative commercial standard classification for feldspar has been drawn up by the United States Bureau of Standards at the request of the Feldspar Grinders' Institute.

Feldspar, one of the important components of porcelain enamel, many kinds of glass, vitreous china, pottery, and, in fact, most products of the ceramic art, has long been a source of misunderstanding between buyer and seller because of its widely variable character and the absence of generally recognized quality designations.

Formerly the material was bought largely on the basis of geographical location of the deposits from which the material was ground, but this has been found to be an unreliable criterion since variations exist within the same deposits.

With the closer control of production in the ceramic industry the users of feldspar are seeking more specific information, so as to reduce the variables in the finished product arising from this source.

To meet this need the producers of feldspar have been cooperating with the Bureau of Standards in the establishment of a standard classification that will become universally understood in the language of their industry.

MINE RESCUE APPARATUS HANDBOOK

A revised edition has been published of the Bureau of Mines handbook entitled "Self Contained Mine Rescue Oxygen Breathing Apparatus." Since the publication of the first edition in 1923, apparatus has been modified or new types developed, and in order that complete information with illustrations may be available for training in mine rescue work this handbook has been amended to include the new equipment. The authors are D. J. Parker, G. S. McCaa, and E. H. Denny.

The NORTHEAST KENTUCKY Coal District

By C. J. NEEKAMP *

Big Sandy Valley towns centering on Ashland, Ky., are progressive and enjoy prosperous year—Double tracking work of Chesapeake and Ohio Railway from Ashland to Elkhorn City important—Well planned readjustment in the industry shows 67 mines in 1929 capable of producing output of 130 mines in 1927—Thought is directed to by-product possibilities.

THE Northeast Kentucky Coal District, referred to locally as the Big Sandy Valley of eastern Kentucky, known from a traffic viewpoint as the Kentucky Division of the Chesapeake & Ohio Railway Company, embodies the counties of Pike, Letcher, Floyd, Martin, Johnson, Knott, McGoffin, Lawrence, Boyd, Elliott, Rowan, Carter, Morgan, and Greenup.

The territory geographically is all included in what is known as the northeast section of the state of Kentucky. Ashland, Ky., one of the most progressive cities in the state, with a population of 36,000 and located at practically its most northeastern point, is the gateway and outlet to all the business activity of the region outlined herein.

Ashland, Ky., is the home of the general offices of the Kentucky Division, Chesapeake & Ohio Railway, and is one of the most important centralization and terminal points on the entire system operated by the Chesapeake & Ohio Railway Company, conceded by competent railroad authorities as one of the key trunk line railway systems of the United States. It is also in the very heart of the Central Ohio Valley industrial region of the Ohio River Valley, and, has been recommended by numerous industrial engineers and business economists as the most strategical location in the United States for manufacturing plant installation and industrial activity. It is located within close proximity to the center of population of the United States and has unexcelled transportation facilities available.

The northeast Kentucky District has several thriving and progressive communities within its borders, chief of which are Louisa, Lawrence County; Paintsville, Johnson County; Prestonsburg, Floyd County; Pikeville, Pike County. These smaller cities have grown and advanced with the development of the territory and, collectively with the district as a whole are now recognized as one of the most progressive sections of the state. The life and progress of these communities is practically dependent upon progressive advancement of this basic industry. Its status is reflected in all the activities of the entire area.

The real development of the Big Sandy coal field of eastern Kentucky started in the year 1906. However, as far back as 1845 companies were formed in the north and opened a mine a few miles above Prestonsburg; another opened mines at Hurricane, 18 miles above the mouth of the river. The entire tonnage production dependent upon river transportation for delivery to markets.

This procedure continued until the E. L. & B. S. Railroad, known as the Chatteroy Road, was completed. This road was first proposed in 1850, and construction started as a narrow gauge railroad; it was changed to a standard gauge road 45 miles long from the Ohio River at Ashland, Ky., to Peach Orchard; it was recognized as the best short line road in the country and was completed in the year 1882. This road was used to haul coal to Ashland, Ky., where it was dumped in barges on the Ohio River. This railroad was finally extended 10 miles farther up the river from Peach Orchard to White House about the year 1887, for the development of quality coal. At the time of this extension the following statement was made: "This road will doubtless soon become a link in the great through line from Chicago to Charleston, S. C., and make the Sandy Valley one of the most prosperous regions to be found in the state."

From this original installation has developed practically a full realization of this statement; while the through service is not a reality the transportation facilities are, and we now have complete railroad connections via the Chesapeake & Ohio Railway from Chicago to Ashland, Ky., and Elkhorn City, Ky., connecting with the Clinchfield, Carolina and Ohio and southern trunk lines to the entire South.

The 45 miles of railroad completed in 1882 to haul coal from Peach Orchard to the Ohio River for transportation has gradually grown into what is now known as the Chesapeake & Ohio Railway, Kentucky Division, operating approximately 250 miles of railroad, and at the present time work is under way which will eventually mean a completed double track main line railway system from Ashland to Elkhorn City. These facilities have proven their necessity by the consistent growth and development of the coal industry in this territory. With the completion of this double track system in the near future 75,000 tons of coal per day can be transported from the mines to consumers. It is remarkable to note that two days' production will then be as large as the entire year's production for the year 1906.

As stated previously, the real coal development did not manifest itself until the year 1906, the production of coal during this year was 124,570 tons. From that day up to the present time there has been a consistent growth in production with the exception of one marked decline in the year 1921. The year 1928 shows quite a decline compared with the years 1926 and 1927, but the year 1929 again shows an increase compared with 1928. It will be noted however, that there has been a decided decrease in the number of mines operating during the last two years. This is due to the general readjustment in the industry which manifested itself with the advent of 1928.

The following report showing the total production of mines in the northeast

* Secretary-Manager of the Ashland Chamber of Commerce, Henry Clay Hotel Building, Ashland, Ky.

Kentucky District each year, and number of mines operating, years 1906 to 1929, inclusive, will give you a comprehensive idea of the consistent growth of the Big Sandy coal field:

Year	No. of mines	Tons produced
1906	No record	124,570
1907	No record	255,000
1908	No record	343,824
1909	No record	469,390
1910	31	986,726
1911	33	1,289,876
1912	42	2,004,487
1913	43	2,665,321
1914	47	2,981,234
1915	51	3,316,185
1916	55	4,440,322
1917	76	4,995,764
1918	118	4 352,591
1919	129	5,062,934
1920	145	5,684,935
1921	162	*3,997,104
1922	177	6,133,077
1923	180	7.464,185
1924	180	8,526,431
1925	178	10.822,260
1926	130	11,101,065
1927	130	11,474,660
1928	67	10 260,985
1929	67	10,672,525

* Sub-normal year.

This growth is due to the progressive production ideals of those actively engaged in the industry in this region, and it is most interesting to note that the question of quality coal is not a new theory in the northeast Kentucky District but had its original inception with the earliest pioneers of the industry.

These early pioneers and their successors, those at present engaged in the further development and production of coal on the eastern Kentucky watershed of the historic Sandy Valley, are the ones to whom great credit is due for blazing the trails through this portion of the beautiful mountain fastness of the great southern Appalachian coal area.

When one gives due consideration to the fact that only one-third of the coal reserve of this area, the northeast Kentucky coal district, is developed and available to transpórtation, and the remaining two-third is undeveloped, virgin territory, it is clearly evident that additional construction of transportation facilities is necessary for the production and movement of additional tonnage.

The reserve coal available in this territory is sufficiently adequate to guarantee an unlimited supply to meet all fuel requirements for generations to come without any danger whatsoever of complete depletion.

The great diversity in composition of the coals, from a high-grade splint coal to an exceedingly splendid by-product coal, all in the bituminous class, permits a greatly diversified use of the coals which are specially adaptable to each classification, and almost in all cases set the present standard.

Millers Creek Block Coal

The extreme hardness of the splendid coals known as Millers Creek Block in this particular locality, permits ready preparation into block sizes, many too large for any man's single strength, with the resultant egg and nut sizes and a very small percentage of slack. The block coal from the district attained a very quick popularity, and in many cases has displaced the use of anthracite in the markets of the middle west. Its distinctive features are its hardness, specially desirable in transportation and storage, its quick ignition, slow consumption and its extremely small percentage of noncombustible material. It is especially adaptable to domestic use in either wood stoves, open grates and all kinds of coal stoves, and its free burning nature makes it almost fool-proof, since it requires but little draft from below or through the fire bed. The egg and nut sizes are very popular in city use in domestic furnaces and cooking ranges, since a quick heat is easily secured for either cooking or heating. The smaller sizes are very much in demand for boiler use, both stationary and locomotive, where free-burning coals are required.

Elkhorn By-Product and Gas Coal

With the extension of the Kentucky Division from White House to Elkhorn City, the upper end of the Big Sandy field was immediately exploited and most of the increased shipments from the district as a whole during the past seven years came from the new development in the Elkhorn coals and several branch lines were necessary to serve this steadily developed area. Adaptable, as experience has demonstrated, to so many and varied uses, the Elkhorn coal is now recognized as the greatest all-purpose coal. As proof of this claim we are showing a few of the particular uses to which this coal has become very popular, viz: domestic stationary, and locomotive use, illuminating and producer gas, malleable iron melting, by-product coking, kiln burning, cement clinkering, annealing, etc.

For gas purposes the Elkhorn coals are rich in carbon and hydrogen, aggregating 86 percent, with little tendency to clinker and carrying a very high caloric value, makes this coal very desirable for this particular use, so that at present a large number of gas plants are specializing on this coal and are producing results that had never been expected from it. Able to stand higher heats than any other gas coal on the market and at the same time maintain good operating conditions in the plant, this coal conforms to the chief requisite in the manufacture of coal gas and tests have shown that this coal will yield the largest amount of gas with the greatest B. t. u. in the gas than any other gas coal.

Elkhorn coal is very rich in the yield of by-products, the resultant coke low in sulphur and phosphorus content has enabled the profitable and economical use of same for the iron and steel industry. Its value for malleable iron smelting is one of its outstanding features. Elkhorn coal contains from 95 percent to 96 percent combustible matter, exceedingly low in ash and sulphur, has little tendency to smoke, soot and clinker, responds quickly to change in draft, which has made it rapidly forge to the front as one of the most desirable of bituminous coals.

In addition to the vast coal resources of this region men of vision and courage have developed a most prolific natural gas and oil development. The natural gas is of extremely high heat unit efficiency. The oil is equal to the highest grade parafine base oils found anywhere within the confines of the world, so with this great development which is producing these products in large volume, combined with a vast reserve proven area for expansion, provides a veritable storehouse of highest rated quality and low cost ratio of fuel energy for the use of the rapidly expanding Ashland industrial district which has made possible Ashland, Ky., northeastern Kentucky's recognized fastest growing progressive city, showing most marvelous industrial strides during the past 10 years.

U. S. POTASH INDUSTRY INCREASES RODUCTION

"American potash production in 1929," says Dr. J. W. Turrentine, in charge of the potash investigations of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, "was maintained on the higher level established in 1928, when substantial gains were made in total output, from 77,000 tons potash salts in 1927 to 104,000 tons in 1928. This important increase in the American production was followed by a marked decrease in the imports of potash fertilizer salts into the United States in 1929. In the first nine months of 1928 the total imports were 672,354 tons, with a value of $14,805,063; in the first nine months of 1929 the total imports were 558,990 tons, with a value of $12,692,300. The decline was 17 percent in tonnage and 14 percent in value. In the same period, however, there was an increase in imports of potash salts for chemical as contrasted with fertilizer purposes, amounting to approximately 20,000,000 pounds, worth slightly more than a million and a quarter dollars, an increase of 41 percent in both quantity and value.

"America still remains the principal market for the foreign potash, which enters transoceanic trade, and takes 32 percent of all the German exports. These figures indicate the size of our tremendous domestic market awaiting domestic supplies of potash," says Doctor Turrentine.

The BITUMINOUS COAL INDUSTRY of PENNSYLVNIA in 1929

By FRANK HALL *

The state a heavy user of coal within itself—Vast investments in mineral operations and greatest coal deposits—The stoker advocated in domestic heating—138,000,000 tons bituminous coal in 1929 valued at $300,000,000 and 16,774,593 tons of coke in 1927 valued at $67,173,146—THINK!—State Department of Mines supervises industry and strives to reduce accidents.

IN 1929 the production of bituminous coal in Pennsylvania amounted to about 138,000,000 net tons, valued at the mines at about $300,000,000.

The bituminous trade has always been subjected to many vicissitudes, to hindrances and interruptions, but regardless of these temporary interferences the production has kept at a fairly satisfactory volume. The highest production ever reached was in 1918, when the tonnage was 177,217,294 net tons. During the past 25 years the tonnage has annually been above 100,000,000 tons.

One trouble with the coal trade, especially the bituminous trade, is over-production, a condition that must be remedied before the operators can hope to enjoy a reasonable profit from their activities, and to effect a remedy there must be intelligent and cordial cooperation.

Another adverse circumstance is competition. There has been a rapid increase in the use of oil and natural gas, as well as electricity. These fuels have made serious inroads into the coal trade by reason of having been intelligently and widely exploited as sources of light, heat, and power.

Some one has said that the people do not want anthracite, soft coal, coke, or gas. What they want is comfortable, safe, and convenient heat, and to meet this general want the oil and gas people have diligently pushed their wares and have recommended and urged the establishment in homes, offices, and factories of equipment necessary for the satisfactory consumption of their product. The coal people have done little more than resort to the old-time methods of advertising.

This is the day of the stoker, an automatic means for handling coal. It is coming into prominence wherever the dealers or consumers are wide enough awake to appreciate its significance as an aid to stove or furnace users. The stoker does away with the necessity for constant attention to the stove or furnace, and when used in connection with the thermostat is a great saver of labor. The value of automatic firing is of great importance and the coal dealers should see to it that their customers adopt this convenient and satisfactory method. The general adoption of the stoker would, undoubtedly, enhance the popularity of coal and increase its consumption.

PENNSYLVANIA'S PROMINENCE

In view of the great value of coal and its importance as a means of perpetuating, maintaining, and increasing the mechanical achievements of the present time, it is a pleasure to note the prominence of Pennsylvania as a producer and user of this universally applied fuel.

Pennsylvania has the greatest coal deposits on the North American continent and more capital invested in mineral operations than any other state. This is an aid and incentive to productive intensity, and it has been thoroughly demonstrated to the commercial and manufacturing interests that our commonwealth possesses resources of concentrated wealth that places it in a position of enviable superiority, and which with increased development and larger utilization will ultimately bring still greater industrial prominence.

The United States produces almost one-half of the entire coal tonnage of the world, and of this amount Pennsylvania produces more than one-third, leading all other states. It is not a matter of surprise, therefore, that capitalists and manufacturers have selected Pennsylvania as the place of their industrial operations.

In addition to the coal that furnishes the dynamic force for our mills and factories and numerous other industrial plants, Pennsylvania possesses a system of railways perfect in organization and complete in equipment, affording rapid, safe, and inexpensive transportation.

The wealth of a state consists, first, in its natural resources, and, second, in the intelligence and industry of its people. This axiom has in Pennsylvania a complete exemplification. Her resources consist of almost every species of raw material essential to making a state great in the three lines of development—agriculture, manufacture, and commerce. These advantages have made Pennsylvania a center of enlightened progress and offer to the capitalist not only the greatest opportunities for commercial investment but the comforts and luxuries that are to be found only among a people of advanced ideas and exceptional culture.

DESCRIPTION OF BITUMINOUS FIELDS—NUMBER OF OPERATORS AND MINES

The bituminous fields are divided roughly into four divisions, as follows: Broad Top, Clearfield, Pittsburgh, and Connellsville, and these are subdivided by the railways for rating purposes into 15 districts, the boundaries of which are not clearly defined.

Bituminous coal is mined in 27 counties, as follows: Allegheny, Armstrong, Beaver, Bedford, Blair, Bradford, Butler, Cambria, Centre, Clarion, Clearfield, Clinton, Elk, Fayette, Fulton, Greene, Huntingdon, Indiana, Jefferson, Lawrence, Lycoming, Mercer, Somerset, Tioga, Venango, Washington, and Westmoreland. The number of operators in the region is about 750 and the number of mines about 2,500. The product of the fields about Pittsburgh is distributed principally through its great waterway, the Ohio River, and the extensive systems of the Pennsylvania Railway and the Baltimore and Ohio Railway. The output from Bedford and Clearfield finds its way to market over the Pennsylvania and New York Central Railways.

* State Department of Mines.

Description of Coals

Bituminous coal is soft and dull in appearance, contains much less carbon than anthracite, but is richer in hydrogen. This is the most important class of coals, because of the great deposits to be found in almost every country and the manifold uses to which it is applied.

Coke

Pennsylvania is also preeminent as a coke-producing state, the annual output amounting to about one-third of the total production of the United States.

In 1927 the output was 16,774,593 tons, valued at $67,173,146. The principal coke districts are in the counties of Fayette, Westmoreland, and Indiana.

The past 15 years have been noteworthy in the coke industry as they mark the awakening of the makers of coke to the fact that the United States has been the most backward of all the great nations in the saving and utilization of the by-products to be obtained in distilling coal. The war in Europe brought to the public suddenly and most effectively the fact that the United States depended almost entirely upon Europe, and particularly upon Germany for dyestuffs. It at once became apparent that the dye industry ought to be placed among the important industries of the country. In the accomplishment of this purpose a change was made in the style of the coke ovens. The old beehive ovens entered a period of eclipse and the by-product ovens began rapidly to grow in number.

Since 1913, when the beehive ovens contributed 73 percent of the total production of coke and the by-product ovens 17 percent, a complete reversal has been accomplished, and today the by-product production is 80 percent and the beehive 20 percent.

Mining Accidents

Many accidents occur in the mining of coal, and occasionally they assume proportions of appalling magnitude. Explosions of gas in the anthracite mines and gas and dust in the bituminous mines create the most havoc, and are frequently attended by scenes of confusion and horror that can only be described by the most vivid word-painting. Such catastrophies, however, are comparatively rare.

The greatest loss of life is caused by the frequent small accidents in which only one or two persons are killed. They are due generally to falls of coal, slate, and roof; mine cars; explosions of powder and dynamite; and blasts. Constant association with danger robs the worker of fear. He grows indifferent to the peril that lurks in the overhanging roof and fails to prop it, and the result probably is death. Or he allows his open light to get too close to the powder and the inevitable flare-up occurs. Or he tries to thaw frozen dynamite with his lamp. Or he will return to his working place after a shot has missed fire, and it very likely goes off with disastrous results. Or he shortens the squib to save time and the squib then burns so quickly that the shot is sent off before he can escape. Or he tries to fire two holes at onces and when one goes off he thinks both have gone off and returns to the working place as the second blast explodes. Or the miner in one chamber fires a shot and fails to notify the miner in an adjoining chamber, who may be killed by the flying coal. Or he attempts to force a cartridge into a hole that is too small with a drill. The drill strikes a spark that sets off the powder and the cartridge explodes in the miner's face. Or he fails to note the approach of the mine car and is run down and crushed.

Fifty percent of the accidents are due to negligence or carelessness.

In 1928, in the anthracite region, there were 449 fatal accidents, a percentage of 2.79 to each 1,000 employes.

In the bituminous region there were 508 fatal accidents, a percentage of 3.68 to each 1,000 employes.

To reduce the hazards of mining has been the chief aim of the Department of Mines, and everything possible in the way of law and suggestion that will tend to the accomplishment of this end has been urged upon the operators and the miners.

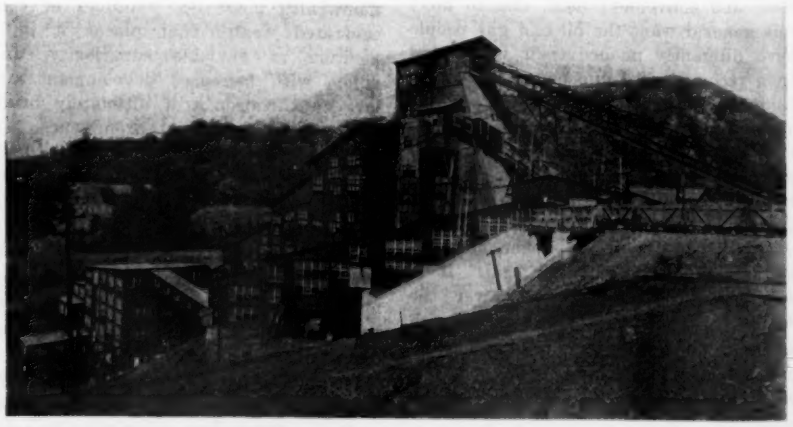
Supervision of Industry

The coal industry, so vital to the welfare of the commonwealth and so tremendous in its commercial import, is under the control and supervision of the State Department of Mines. The Secretary of Mines receives his appointment from the Governor for a term of four years. He has supervision of the execution of the mining laws.

Under the act of 1927 the department was reorganized, and the departmental force was increased by the addition of two deputy secretaries appointed by the Governor. These officials are experienced mining men and their duty is to supervise the work of the state mine inspectors, one having charge of the anthracite region and the other the bituminous region. They are located at Harrisburg and are under the control of the Secretary of Mines.

The mine inspectors are men versed in the art and science of mining. The present force consists of 55 inspectors, 25 in the anthracite region and 30 in the bituminous region. They are appointed by the Governor for a term of four years, after passing an examination before a board appointed by the Governor. They are all required to have practical and theoretical knowledge of mines and mining and of the different systems of working coal seams. The anthracite inspectors are required to have at least five years' practical experience in the anthracite mines of Pennsylvania, including mines in which explosive gas and other dangerous gases are found. The bituminous inspectors are required to have at least 10 years' practical experience in bituminous mines, including five years in the bituminous mines of Pennsylvania, and are also required to have had practical experience with explosive gas and other dangerous gases found in mines.

The mining laws of the state, particularly those relating to the bituminous mines, are comprehensive and practical. The bituminous code of 1911 is perhaps the most advanced mining code in existence. It represents the experience of years and embodies the salient and valuable provisions of all previous legislation. It is recognized as a model among mining authorities.



The OHIO COAL MINING INDUSTRY in 1929

By H. E. NOLD * *and* E. W. SMITH †

Ohio operators now in midst of educational and selling campaign looking to rehabilitation of industry—Progress made in coal-cleaning methods—The trend toward mechanization—Tendency toward steady employment for fewer men

Prof. H. E. Nold

WERE it not for the persistent continuation of low prices, the condition of the coal industry in Ohio might be viewed quite optimistically. After two years of virtual inactivity due mainly to a noncompetitive wage scale, the Ohio mines are now in a position to produce coal at a cost such that they can compete with other coals over a considerable territory.

The coal producers are in the midst of an active educational and selling campaign to reestablish Ohio coals in markets formerly using this coal but, in recent years, served by the cheaper coal from other states. The success of this campaign is shown by a total production in 1929 of about ‡24,000,000 tons, which is an increase of 8,900,000 tons, or about 60 percent over 1928. With the exception of perhaps two of the smaller districts, this increase has been general throughout the state.

In rehabilitating this great industry the mine operators have generally adopted the policy of providing as near steady work for their men as possible. This means that not all the mines in Ohio have been operating, but in general those that have operated have done so on nearer a full-time basis than has recently been the custom. In other words, the policy now is to give relatively few men rather steady employment instead of providing irregular employment for many men.

The table in the next column summarizes statistics gathered in the office of E. W. Smith, chief of the Division of Mines in Ohio, and shows the situation as of December, 1929.

* Professor Mine Engineering, Ohio State University.

† Chief of Division of Mines, State of Ohio.

‡ Preliminary estimate U. S. Bureau of Mines.

§ There are equally well-prepared coals being shipped from mines working other seams but analyses of these coals, made on the same basis as those given, were not available at the time of publication of this circular.

COAL PREPARATION

"Clean coal" is the common slogan around the mines. Strenuous efforts are being made, both underground and on the surface, to prepare a clean product. The men in the mines seem to realize that their future means of livelihood depends largely on their ability to produce clean coal, and their hearty cooperation to accomplish this is one of the bright spots of 1929.

In order to insure a better product, three Ohio tipples have recently been equipped with wet washing plants. These plants wash the minus 4-in. to ½-in. sizes. The minus ½-in. coal being left untreated. One Ohio mine has been equipped with a wet washing plant to treat minus 4-in. to dust. This mine, in eastern Ohio, loads most of its coal mechanically. No effort is made to clean the coal underground; in fact, the hand loaders are forbidden to clean the coal at the faces. Extraneous impurities and coal are sent to the outside. The plus 4-in. material is hand picked and the minus 4 in. is washed. This is on the theory that cleaning and sorting can be done more cheaply on the surface than underground.

That the efforts to produce clean coal are producing results even in mines not using washers is shown by the following, quoted from "Mining and Cleaning Domestic Coal in Ohio," Circular No. 19, the Engineering Experiment Station, of the Ohio State University, Columbus, Ohio, published in November, 1929:

We are giving below a few analyses§ of coal 'as shipped' so that the reader may have an idea of what to expect when purchasing Ohio coal that has been properly prepared at the mine. These analyses in each case are of recent samples representing one or more full days' output of a representative mine.

Number of coal mines in operation, employing more than 10 men	386
Number of coal mines in operation, employing 10 men or less	711
Total number of coal mines operating in December, 1929	1,097
Number of mines, normally employing more than 10 men but idle during *all* of 1929	50
Number of mines abandoned during 1929	42
Number of new mines opened (mostly small)	20
Number of men employed in coal mines employing more than 10 men	25,190
Number of men employed in coal mines employing 10 men or less	3,135
Total men employed in coal mining (December, 1929)	28,325

OTHER MINING ACTIVITIES IN OHIO

Total number of clay mines operating	45
Total number of men employed in clay mines	435
Total number of gypsum mines operating	3
Total number of men employed in gypsum mines	215

*No. 8 or Pittsburgh Coal**—

	Lump ¾-in. and larger	Mine run
Moisture	1.65	1.55
Volatile matter	42.95	42.25
Fixed carbon	48.60	49.05
Ash	6.80	7.15
Sulfur	4.20	4.05
B. t. u.	13,785	13,735

No. 6 or Middle Kittanning Coal†—

	Lump 4-in. and larger	Egg 4 x 1½ in.
Moisture	7.17	7.15
Volatile matter	39.23	39.34
Fixed carbon	47.50	47.55
Ash	6.10	5.96
Sulfur	1.30	1.17
B. t. u.	12,462	12,437

* Average sample of five days' run at one mine.
† Average of one day's run of eight different mines.

It is the writer's opinion that the shipping of a well-prepared product is one of the important elements which are aiding in the rehabilitation of the Ohio coal industry.

MECHANIZATION

In three mines, producing together about 5,500 tons per day, the coal is entirely mechan- (*Continued on page* 86)

COAL MINING Conditions in COLORADO in 1929

Late spring followed by very mild fall evened demand with 1928—Improved preparation a factor—Routt County continues to install power shovels, conveyors, and pit-car loaders—Other fields giving serious thought to mechanization underground

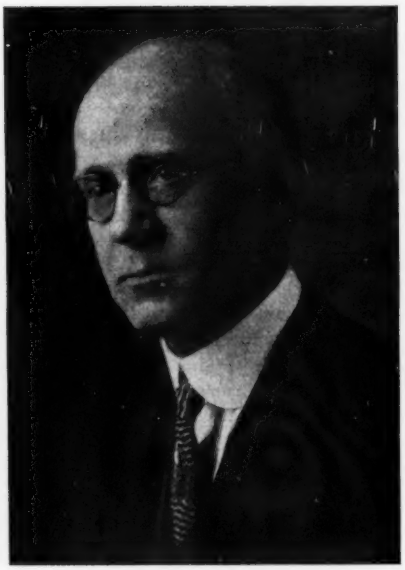
By BENEDICT SHUBART *

THE past year was not a very kind year to the operators of Colorado. The introduction of natural gas proved a definite setback to the domestic coal industry, and has somewhat affected industrial coal. Nineteen twenty-nine saw an extension of gas to many smaller towns, and 1930 promises a very menacing invasion of the industrial field.

Weather conditions in 1929 were not particularly friendly either. Although autumn of 1929 was unusually cold and wintry, very little demand was stimulated by it, and it has been followed by a long period of warm weather. The estimated production of 9,928,000 tons of coal for 1929 is a little more than the production for 1928, which was 9,221,000 tons.

There was comparatively little new development of mines, nor very much improvement in top works. The MacGregor shaft of the McNeil Coal Company and the new slope of the Moffat Coal Company, both in Routt County, were put into production. The Calumet Fuel Company installed a new tipple at Calumet No. 2 mine, the Colorado Fuel & Iron Company is busily engaged in building the new Salida screening plant and transfer for taking coal from narrow-gauge cars, preparing it and reloading it into broad-gauge cars, and the Bear Canon Coal Company is going ahead with their new tipple and spiralizing plant, replacing the one recently burned.

Some progress was made in mechanical mining, particularly in the Routt County district, where power shovels, jigging conveyors, pit-car loaders, and some special loading conveyors were put into service. Routt County stands out as the one Colorado coal field that has seriously taken up mechanical loading. In the Trinidad and Walsenburg districts, as well as in Routt County, some experiments are being carried on with Cardox shooting. Due to the difficult mining conditions in Colorado, together with restrictive laws regarding shooting, the success of Cardox will mean a new hope of betterment in mining economy.



Benedict Shubart

In general, the state feels that there will be some improvement in coal-mining prosperity during 1930. In spite of the setbacks of 1929, there seems to be a trend toward more economical mining, toward the elimination of the less efficient mines, and in some cases a decided improvement in the financial conditions of some of the mining companies. The introduction of gas has perhaps reached its apex as far as harm to the coal industry is concerned. Industrial conditions throughout the state appear unusually good. The coal operators themselves have shown their faith in the future by consistent, though not elaborate, improvement "inside" and "on top."

OHIO COAL IN 1929

(*From page 85*)

ically loaded. In two more the coal is partly mechanically loaded. Several mines are using pit-car loaders, in part, and the installing of mechanical-loading equipment is reported to be contemplated in several more mines. All these mines are using the room and pillar system of mining.

ACCIDENTS

There is an increasing interest, on the part of both operators and miners, in accident prevention. Safety engineers, or their equivalent, have been added to the staffs of a number of companies. The state division of mines has given first-aid instruction in a number of mining centers during the year. The fatality rate for Ohio has shown a marked improvement, as shown by the following:

Fatalities in 1928	71
Tons mined per fatality in 1928	212,600
Fatalities in 1929	78
Tons mined per fatality in 1929	307,600

LABOR SUPPLY

Although the number of men employed is much less than previous to 1927, there is little excess labor supply in the coal fields. Many single men have found work in other lines of industry, and even many married men have left the mines, often taking their families with them. The purchasing power for the miners is still, in many instances, curtailed by the payment of debts incurred during the lean years of 1927 and 1928, yet each month is seeing an improvement in the economic situation in the coal-mining towns.

* Secretary, Rocky Mountain Coal Mining Institute.

BITUMINOUS COAL in INDIANA IN 1929

By CARL J. FLETCHER *

In spite of difficulties Indiana production increased in 1929 over previous year's record—Greater tonnage per man employed has resulted through use of mechanized mining—Inability to arrive at satisfactory agreement with workers caused serious losses

THE year 1929 will show an increase in tonnage mined and marketed by the Indiana operators as compared with 1928.

For some years the operators have been unable to make an agreement with their employes which would enable them to protect their investments and as a result Indiana has shown a steady loss in tonnage to more fortunate fields.

The increase in tonnage in 1929 will amount to approximately two million tons and indicates that Indiana has started to regain the tonnage which has been lost. This gain in tonnage has been made under conditions which have placed a greater burden on the Indiana operator than he has ever experienced and for that reason it would appear that the gain in tonnage should be greater for the coming year.

The Indiana operators although bound by a fixed cost and facing a lowering realization have found means which have permitted the continuation of operation and in some cases shown an increase in tonnage.

It has been possible in some cases to establish a better understanding between the operator and the miner which has resulted in a mutual benefit and a production of tonnage which would otherwise be lost.

The introduction of additional machinery and the more skillful use of machinery already installed has resulted in a greater tonnage per man employed which has resulted in an increased tonnage. The operators of stripping plants by reason of the fact that their properties were newer and also did not present the difficulties in the use of loading machinery which the shaft operators face have been able to invest more freely in machinery and have been more successful in increasing tonnage than the shaft operators.

There has been a considerable property loss among the operators where it was

impossible to reach a satisfactory agreement with the worker and where conditions did not justify an additional investment in labor-saving machinery but the forced liquidation of productive capacity may offer the only sound solution to the problems that face the industry at the present time.

ALABAMA COAL IN 1929

(From page 78)

their livestock or marketing through their commissaries each year many million dollars worth of the products of the farms, orchards and truck gardens of Alabama, and would purchase as much more again if these products were available. Every ton of hay produced for sale from Alabama farms last year that passed Government grade was marketed through the purchasing departments of the coal, iron and steel producers of the Birmingham district, and every bushel of corn and oats raised for market in Alabama was bought and used by them; to say nothing of the large amount of milk, butter, eggs, poultry, cattle, hogs, and other livestock, fruits and produce, together with large amount of cotton goods and cotton-seed products (raised on the farms and in the gardens of the state), that found an advantageous market through the company stores, or commissaries of the coal operators of Alabama.

In the above manner and by the above means of marketing the products of the farms through the commissaries of these coal producing concerns a great deal has been accomplished in emancipating the Alabama farmer from the one-crop despotism ("cotton"), and to enable him to raise a diversity of products from the fertile soil which abounds throughout the state; and to open up to the farmers a new domain of trade for diversity of commodities grown on his own ground and to permit him between work hours to bask in the sunshine of better prospects and rest in the security that the boll weevil will not blight the fruits of his labor.

Space does not permit of a delineation of the incidental and reflex benefits that come from the mining of coal to the people engaged in transportation, manufacture and production of supplies used and consumed by the coal mining industry and to those that are dependent for a living upon the metallurgical and other industries requiring heat and power made from coal in their processes of manufacture and in the operation of their plants. Therefore it must suffice to say, that the coal mining industry is an essential source of sustenance or means of livelihood as well as a provider of comfort, to many thousand people in Alabama and elsewhere, not only those employed directly in producing the coal, but to those engaged in other lines of business and endeavor, including public servants and school teachers.

* President, Old Knox Mining Co.

LEGISLATIVE Review

Senate still struggling with tariff revision bill—Coal regulation measure reappears—New chairman of House Mining Committee—Restriction of Mexican immigration—Corporation license and profit limitation

CONGRESS is literally up to its neck in a maze of legislative proposals which promises to keep it busy for the next several months. Problems, both foreign and domestic, are pressing for attention and there is a feverish activity in the halls of Congress and its committee rooms in an effort to pick out the best of the plans and to discard those unworthy of legislative enactment. The sessions of the disarmament conference which are being held in London and to which there are two Senatorial delegates, adherence of the United States to the World Court and immigration restriction proposals affecting countries of the western hemisphere comprise the international problems which are facing Congress. In the field of domestic legislation, Congress has before it recommendations of the Law Enforcement Commission for unified border control covering immigration, customs and prohibition under the Coast Guard, and proposals for reform in judicial procedure and prohibition enforcement in order to clear the courts of their congested dockets. Another new proposal is for the establishment of load lines on vessels on the Great Lakes and in the coastwise and intercoastal trade, proposed by the Department of Commerce.

The Senate is giving its undivided attention to the tariff revision bill which has been pending in Congress for more than a year and hopes to dispose of the measure by the middle of February. The House is giving exclusive consideration to bills making appropriations for the Government departments during the year beginning July 1 next. By reason of recent changes in membership there have been realignments in a number of the committees. When Representative John M. Robsion, Republican, Kentucky, went to the Senate as the successor of Senator F. M. Sackett, who was appointed Ambassador to Germany, he was succeeded by Representative W. H. Sproul, Republican, Kansas. Finding his duties as chairman of the Public Lands Committee and his membership on other committees too engrossing, Representative D. B. Colton, Republican, Utah, resigned from the Mines and Mining Committee. Senator Robsion has become a member of the Banking and Currency Committee as have also Senators Blaine, Republican, Wisconsin; Grundy, Republican, Pennsylvania; and Baird, Republican, New Jersey. Senator Gould, Republican, Maine, succeeds Senator Johnson, Republican, California, as chairman of the Immigration Committee, the California member becoming chairman of the Commerce Committee in place of Senator Jones, Republican, Washington, who takes the chairmanship of the Appropriations Committee. Senators LaFollette, Republican, Wisconsin, and Thomas, Republican, Idaho, are new members of the Finance Committee; Senator Grundy of the Manufacturers Committee and Senator Hastings, Republican, Delaware, of the Committee on Interstate Commerce.

Senator Watson, Republican, Indiana, reintroduced his bill which was presented in the last Congress at the request of Miners Union to license and regulate bituminous coal producing and shipping companies under a coal commission and authorizing consolidations and cooperative marketing in the industry. Another bill coming over from a previous Congress is one by Representative Douglas, Democrat, Arizona, authorizing the issuance of patents to lands containing copper and associated minerals at depth.

Mineral producers who have been advocating a Federal high-grading act will be interested to learn that the House Committee on Judiciary has favorably reported what is known as the national stolen property law, which it is said protect shipments of minerals. Senator Wagner, Democrat, New York, has proposed that an American conservation week be established in March to perpetuate the conservation of natural resources.

The Senate has passed and the House Committee on Public Lands has reported a bill granting an extension of three years to oil and gas prospecting permits, and new bills have been presented authorizing the lease of oil and gas in or under railroad and other rights of way. At the suggestion of the Navy Department a bill has been introduced giving it authority to operate and protect the naval petroleum and oil shale reserves.

Advocates of restriction of immigration from Mexico, led by Representative Johnson, Republican, Washington, Chairman of the Committee on Immigration, are sponsoring a bill to restrict immigration from countries of the western hemisphere to fifty thousand aliens a year beginning July 1, next, on the basis of three times the number of Americans who went to those countries for permanent residence in 1929.

Although the House Committee on Public Lands reported during the middle of December a bill authorizing an appropriation of fifty thousand dollars for expenses of the Public Land Commission appointed by the President, no action has been taken on the matter by the House, although the Rules Committee has placed the measure on the legislative program.

A bill for the licensing of corporations by the Federal Trade Commission and the limitation of their profits to 5 percent of their capital investments has been introduced by Senator Brookhart, Republican, Iowa.

The following is a summary of pending bills:

Coal Regulation

S. 2888. Mr. Watson (Rep., Ind.). This bill, which is similar to a measure introduced in the last Congress at the request of the miners union, provides for a bituminous coal commission to regulate interstate and foreign commerce in bituminous coal. It provides for consolidations, mergers, and cooperative market agreements in the industry, and the licensing of corporations producing and shipping coal in interstate commerce. It also regulates the fuel supply of interstate railroads and would forbid contracts by operators with labor which forbid the workers from joining a labor union. Interstate Commerce.

H. R. 8286. Mr. Douglas (Dem., Ariz.). This bill, which is also a holdover measure from a previous Congress, would authorize the issuance of patents for lands containing at depth copper, lead, zinc, gold, or silver and their associated minerals, in not to exceed 320-acre tracts. Public Lands.

H. R. 119. Mr. LaGuardia (Rep., N. Y.). This bill, known as the national stolen property law, would prohibit the sending and receipt of stolen property through interstate and foreign commerce. It is said the measure would ap-

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The South Portico of The Memorial Continental Hall

The thirteen columns of this portico of the beautiful headquarters building of the Daughters of the American Revolution are each named for one of the original colonies. The new Constitution Hall in the background

ply to metals and minerals, for which producers have been seeking a Federal high-grading act. Reported by the House Committee on Judiciary.

S. Con. Res. 23. Mr. Wagner (Dem., N. Y.). This resolution proposes to establish an annual conservation week in March to perpetuate the conservation of natural resources. Under the resolution the President would designate the third week in March for the observance of conservation. Public Lands.

Prospecting Permits

S. 1752. This bill authorizes a three-year extension of oil and gas prospecting permits. Passed by the Senate and reported by the House Committee on Public Lands.

S. 3074. Mr. Nye (Rep., N. Dak.), by request; and H. R. 8154, Mr. Coulton (Rep., Utah). These bills authorize the Interior Department to grant leases of oil and gas deposits in or under railroad and other rights of way, the Government to receive a royalty of not less than 12½ percent of the value of the production for not more than 20 years. Public Lands.

H. R. 7934. Mr. Britten (Rep., Ill.). This bill, introduced by request of the Navy Department, authorizes that department to operate and conserve the naval petroleum and oil shale reserves. One of its provisions would forbid the holding of any interest in a lease to the reserves by a citizen of another country whose authorities forbid Americans from holding mineral rights in those countries. Naval affairs.

H. R. 8530. Mr. Johnson (Rep., Wash.). This bill proposes to restrict immigration from Mexico and other countries of the western hemisphere to 50,000 aliens per year beginning July 1, 1930. The number to be admitted from each country would be three times the number of Americans who departed for permanent residence in such foreign country in 1929. Immigration.

H. R. 8523. Mr. Box (Dem., Tex.). This is similar to the foregoing. Immigration.

H. R. 6153. Mr. Colton (Rep., Utah). This bill appropriates $50,000 for the expenses of the Commission appointed by the President to report on the conservation and administration of the public domain by next December. Reported by the House Committee on Public Lands.

H. R. 8284. Mr. Cramton (Rep., Mich.). This bill would abolish the Platt National Park in Oklahoma and convert it into a state park. The bill reserves to the Government the mineral deposits in the land. Public Lands.

Wage Stabilization

H. J. Res. 162. Mr. Sabath (Dem., Ill.). This bill proposes to aid industry and labor by stabilizing wages during the present emergency. It is provided that no article may be shipped in interstate commerce if it has been mined or produced under a wage scale less than that prevailing in 1929. Interstate Commerce.

S. 3060. Mr. Wagner (Dem., N. Y.); H. R. 8374, Mr. Cable (Rep., Ohio); and H. R. 8655, Mr. Mead (Dem., N. Y.). These bills authorize a national employment system under the Department of Labor, to aid in establishing public employment offices throughout the states. The Wagner bill authorizes yearly appropriations of $4,000,000 and the Mead bill $2,000,000 for the first year and $4,000,000 per year until June 30, 1934. The Wagner and Mead bills also provide for the giving of notice of strikes or lockouts to applicants for employment. The Wagner bill was referred to the Commerce Committee and the House bills to the Judiciary Committee.

H. J. Res. 169. Mr. Mead (Dem., N. Y.). This resolution proposes a committee of the House and Senate to investigate the unemployment situation and to report recommendations to remedy it. An appropriation of $30,000 for its expenses is provided. Rules.

S. 3061. Mr. Wagner (Dem., N. Y.) This bill would authorize the bureau of labor statistics to publish monthly statistics as to the volume and changes in employment, wages paid, and hours of employment in the mining, quarrying, crude petroleum production, and other industries. Commerce.

S. 3059. Mr. Wagner (Dem., N. Y.). This bill would appropriate $150,000,000 in any one year to relieve unemployment, by providing for the construction of public works during such time. Commerce.

Labor Inquiry

S. Res. 196. Mr. Wheeler (Dem., Mont.). This resolution would authorize the Committee on Labor to investigate and report legislation forbidding industrial espionage. The resolution points out that private detective agencies obtain money from organizations by falsely representing movements among their employes and by joining labor organizations advocate revolutionary methods to discredit the labor organizations and manufacture scares concerning radical propaganda and plans for the use of violence in industrial conflicts. The resolution declares that these agencies are detrimental to peaceful relationships between employers and employes and bring about strikes. Labor.

H. R. 7977. Mr. Lankford (Dem., Ga.). This bill would establish a Department of General Welfare at an annual expense of $1,000,000,000. Among the duties of this department would be to aid, encourage and promote labor federations, schools, churches, lodges, farm organizations, war veterans societies, patriotic clubs, community gatherings, and other legal assemblies and organizations. The department would make available for these organizations motion picture films and radio service which would be furnished to the public without expense. Expenditures in Government Departments.

H. R. 7995. Mr. Bacon (Rep., N. Y.). This bill would require Government contractors to give preference to American citizens in their employment of labor. Labor.

H. R. 8646. Mr. Mead (Dem., N. Y.). This bill proposes to establish an eight-hour day for certain railroad employes. Labor.

H. R. 7501. Mr. Griffin (Dem., N. Y.). This bill would authorize the issuance by the Government to its employes for distinguished work in science of a medal and an annual award of between $100 and $500. Library.

S. Res. 191. Mr. Sheppard (Dem., Tex.). This resolution provides for an inquiry as to the advisability of requiring the Department of Commerce to investigate and determine for the information of individuals and organizations as to the smallest amount of capital, labor and machine units with which and the smallest distribution areas in which articles of common use may be profitably manufactured for sale. The committee would inquire as to the advisability of requiring the Department of Agriculture to determine the extent to which small factories (*Continued on page* 91)

IMPORTANT BILLS REVIEWED IN THIS ISSUE

Mining

S. 2888—Watson (R., Ind.). Coal Regulation.
H. R. 8286—Douglas (D., Ariz.). Mineral Patents.
H. R. 119—La Guardia (R., N. Y.). Stolen Property Law.
S. Con. Res. 23—Wagner (D., N. Y.). Conservation Week.
S. 1752—Prospecting Permit Extension. Passed by Senate.
S. 3074—Nye (R., N. D.). Oil Leases.
H. R. 7934—Britten (R., Ill.). Oil Reserve Supervision.

Industrial

H. R. 8530—Johnson (R., Calif.). Mexican Immigration Restriction.
H. J. Res. 162—Sabath (D., Ill.). Wage Stabilization.
S. 3061—Dagner (D., N. Y.). Mine Employment Statistics.
S. Res. 191—Sheppard (D., Tex.). Diffusion of Manufacturing.
S. J. Res. 20—Reed (R., Pa.). Industry Control in War.
S. 2847—Brookhart (R., Iowa). Corporation License.
S. 2964—Robinson (D., Ark.). Steel Cars.

Bituminous Coal LEGISLATION

Presidential, Governmental and Congressional commission inquiries—Probes cover strike conditions and legislative remedies

COAL appears to be a perennial subject for inquiry on the part of Congress and Presidential and governmental commissions. While the anthracite industry has come in for its share of investigation, the bituminous industry has borne the major brunt in these probes. During the past quarter of a century a score or more of these investigations have been conducted. Some have been carried on by committees of the House and Senate, others by special commissions appointed by the President or Congress and still others by regularly established governmental commissions. Out of this welter of inquiry, probing and fact-finding, some critical and others of a mediatory nature, no outstanding accomplishment has been achieved other than to put an end to the irritant which caused the investigation to be undertaken. Scores of bills proposing legislation to subject the coal industry to government regulation through existing government agencies or a specially created commission, and to regulate the shipment of coal have been introduced in Congress, but none of them have carried sufficient force behind them to permit of their enactment. The only concrete result of such inquiries appears to have been the settlement by the industry itself of wage scale agreements in those investigations which sought to pacify deadlocks developed between operators and miners since the war.

The halls of Congress have resounded to the echo of statements pro and con on coal legislation in the last ten years as with the return of the country to normal conditions as an aftermath of the war, high prices and strikes were the contributing factors to the constant probing of the industry. Committee rooms in both the Senate and the House were the scene of lively tilts between the opposing camps both among the witnesses and the committee members who exchanged views on the issues involved. Personalities were indulged in and the private books and papers of some of the witnesses examined by investigators retained by the committee. Extra legal talent was engaged on both sides to present the views of contending factions. In one committee of the House the advocates of a coal control bill failed to muster enough votes to report the measure and in the Senate a bill authorizing lower freight rates on coal in summer than in winter designed to overcome transportation gluts in winter was beaten. During the course of the drive for government control of the coal industry, representatives of other industries appeared unasked by the coal men to fight what was regarded as an attempt to inject government into business generally as it was felt that coal regulation would be an entering wedge which would lead to federal direction of private enterprises. In this onslaught against the measure appeared the U. S. Chamber of Commerce, the National Manufacturers Association, the railroads and other national business organizations who feared the spectre of the government ruling industry.

Operators United

Throughout the coal controversy the operators were a unit in opposing regulation of the industry while the union first opposed in 1926 before a House Committee and later in 1928 before a Senate Committee favored such legislation.

Many of those who occupied conspicuous positions in this battle over coal in Congress have since passed from the scene either voluntarily or otherwise. Senator R. M. LaFollette, Sr., of Wisconsin, and Representative John I. Nolan, of California, who as Congressional Committee Chairmen conducted coal strike and price inquiries, have since died, as has President Wilson, who appointed a bituminous wage commission, whose report was not satisfactory to the union. Another who died was Edgar Wallace, legislative representative of the American Federation of Labor. The coal industry also suffered a loss in its ranks during this time in the death of Col. Daniel B. Wentz, of Philadelphia, president of the Stonega Coal and Coke Company, who was among those operators who opposed regulatory legislation.

Senator W. S. Kenyon, of Iowa, who inquired into the outrages incident to a march of the union on the coal fields in West Virginia, is now a federal judge and a member of the President's Law Enforcement Commission. Senator W. S. Calder, of New York, who proposed a government coal regulatory body, is out of public life, while Senator J. S. Frelinghuysen, of New Jersey, who conducted an inquiry and favored the seasonal rate bill served only one term, was an unsuccessful candidate for another term last year and has announced his candidacy for the election this fall. Senator James A. Reed, of Missouri, who opposed the Frelinghuysen bill voluntarily retired last year, and Senator A. O. Stanley, of Kentucky, who joined in the opposition was defeated for reelection, but reappeared last year in the hearings before the Senate Committee on Interstate Commerce in opposition to federal control of coal as counsel for southern operators.

The galaxy of coal operators and coal company officials who appeared before congressional committees in opposition to coal legislation included such leading figures in the industry as Col. William H. Coolidge, of the Island Creek Coal Co.; Ezra Van Horn, of the Clarkson Coal Mining Co.; Josiah Keeley, of the Cabin Creek Consolidated Coal Co.; H. E. Willard, of the United States Coal Co.; W. L. Robison and H. L. Findlay, of the Youghiogheny and Ohio Coal Co.; J. D. A. Morrow and C. E. Lesher, of the Pittsburgh Coal Co.; R. L. Ireland, of the Pittsburgh and Eastern Coal Co.; Horace F. Baker, of the Pittsburgh Terminal Coal Corp.; and J. G. Bradley, of the Elk River Coal and Lumber Co.

Colorado Inquiry

The first bituminous inquiry on the part of Congress which was the forerunner of the many others that followed, was held in 1914 by the House Committee on Mines and Mining and concerned itself with the bloody conditions in the coal fields of Colorado growing out of an attempt to unionize the coal fields of that State, particularly those of the Colorado Fuel and Iron Company. This inquiry was headed by Representative Foster, of Illinois, Chairman of the Committee and resulted in pacification of the trouble and open-shop operation by the company.

In 1917 the Senate Committee on Manufactures conducted an investigation into the shortage of coal and its price due to war conditions. Congress also passed the fuel control act by Representative Lever, of South Carolina, which authorized the President to fix the price of coal and to regulate its distribution which was handled by the Fuel Administration headed by Dr. Harry A. Garfield, and on which representatives of the coal industry served in an advisory

capacity. After the close of the war numerous court suits were instituted to recover higher prices for coal than those fixed by the Fuel Administration, and for damages growing out of its diversion of coal for war purposes. Senators Reed and LaFollette were active in the investigations by the Manufactures Committee.

Authority was given the Federal Trade Commission by the House Appropriations Committee during the war to investigate fuel in connection with cost of living studies. The commission sought to compel coal and steel interests to produce cost of production data, but its effort failed in court proceedings. Based on such data as it could otherwise obtain the commission issued cost reports in 1919 on bituminous in Pennsylvania, Illinois, Alabama, Tennessee, Kentucky, Maryland, Virginia, West Virginia, Ohio, Indiana, Michigan and the trans-Mississippi States. Up until 1922 it investigated and issued reports on investments and profits in the bituminous industry and in 1922 and 1923 conducted investigations for the Coal Commission.

In 1920 President Wilson appointed a Bituminous Wage Commission which recommended a new wage scale, but which was not satisfactory to the union member, who filed a minority report.

Seasonal Rates

Three investigations were conducted in 1921. One was held by the Senate Labor Committee, headed by Senator Kenyon into the West Virginia strike situation. Another was by a special Senate Committee headed by Senator Frelinghuysen and related to high coal prices. He recommended a bill authorizing lower freight rates on coal during the summer, but it was sent back to committee by the Senate. Another bill recommending government regulation of the industry was not voted on. The third was by the Senate Committee on Manufactures, in charge of Senator Calder and concerned production and profits during which the committee seized records of the National Coal Association.

The House Committee on Labor in 1922 under the leadership of Representative Nolan conducted an inquiry looking to settlement of a coal strike.

During the coal and railroad shopmen's strike in 1922 Congress created a Federal Fuel Distributor who cooperated in the distribution of coal to prevent shortages and high prices. F. R. Wadleigh was the last man to hold this office when restoration of normal conditions in the coal industry permitted its discontinuance.

As a result of the numerous strikes in the industry during and following the war, Congress, on recommendation of President Harding, who held numerous conferences with operators and miners, authorized a Coal Commission, which conducted in that year and in 1923 a thorough investigation of the industry at an expense of more than $600,000. This commission was headed by John Hays Hammond, eminent mining engineer, and recommended control of the industry through a government bureau. Its recommendations were taken up in the House Committee on Interstate Commerce in 1926. After exhaustive hearings in which the American Federation of Labor opposed the legislation, through Edgar Wallace, its legislative representative, its advocate failed to muster enough votes to report the bill, resulting in its death. Representative James S. Parker, of New York, was and remains chairman of this committee.

Union Bill

The last investigation was conducted in 1927 and 1928 by the Senate Committee on Interstate Commerce, headed by Senator James E. Watson, of Indiana, Chairman, who is now the Senate leader. This investigation was secured by the miners union and covered conditions in Ohio, Pennsylvania and West Virginia, growing out of the suspension of union miners. Senator F. R. Gooding, of Idaho, since deceased, headed a subcommittee which visited the Pennsylvania fields and Senator Watson introduced for discussion a proposed coal regulatory bill drafted by the miners union. John L. Lewis, president of the union, was active in the hearing, aided by counsel, which was marked by frequent clashes with the operators and their attorneys. This bill was never reported out of a subcommittee to which it was referred because of the strong opposition manifested against it by the coal and other industries.

Since this investigation there was a lull in the Congressional probing of the industry and in bills seeking its regulation, until early in January of this year when Senator Watson re-introduced the union coal regulatory bill. As the Senate Interstate Commerce Committee is actively considering legislation to control communication services, it is not certain when the coal bill will be taken up.

LEGISLATIVE REVIEW

(*From page 89*)

may be operated on the farm, in farm communities, villages or elsewhere. Manufactures.

S. J. Res. 20. Mr. Reed (Rep., Pa.). This resolution authorizes a commission on which labor, industry, capital and the professions would be represented to investigate and report next December proposed legislation authorizing the use by the Government of all the resources of the country during war, in order to equalize its burdens and to minimize its profits. Reported by the Senate Committee on Military Affairs.

H. R. 7831. Mr. Arentz (Rep., Nev.). This bill proposes to aid in the promotion of engineering research by authorizing appropriations of $20,000 for the current year, $30,000 for 1931, $40,000 for 1932, and $50,000 for each year thereafter to each state which operates an engineering experiment station. Agriculture.

Corporation License

S. 2847. Mr. Brookhart (Rep., Iowa). This bill provides for the licensing of corporations engaged in interstate or foreign commerce under the Federal Trade Commission, and limiting their profits to 5 percent per year on their capital investment. Interstate Commerce.

S. 3043. Mr. Ransdell (Dem., La.); H. R. 8299. Mr. O'Connor (Dem., La.). These bills appropriate $350,000 for the establishment of a national hydraulic laboratory in the Bureau of Standards to determine fundamental data useful in hydraulic research and engineering. Commerce and Rivers and Harbors.

S. 3033. Mr. Wagner (Dem., N. Y.) by request. This bill is known as the federal sales act and prescribes regulations concerning sales and contracts in interstate and foreign commerce. Interstate Commerce.

H. R. 7927. Mr. Green (Dem., Fla.). This bill appropriates $50,000 for the establishment on the Osceola national forest in Florida of a naval stores experiment and demonstration station. Agriculture.

H. J. Res. 185. Mr. Ludlow (Dem., Ind.). This resolution authorizes an investigation and report by December, 1931, by a commission of three Representatives, three Senators and three members recommended by the American Bar Association who are authorities on constitutional law, as to the centralization of power in the government departments. The commission is to report steps to be taken to restore the government to its original purposes and to redistribute the power of the government so as to define the limits of federal power and to counteract centralization of government power. Rules.

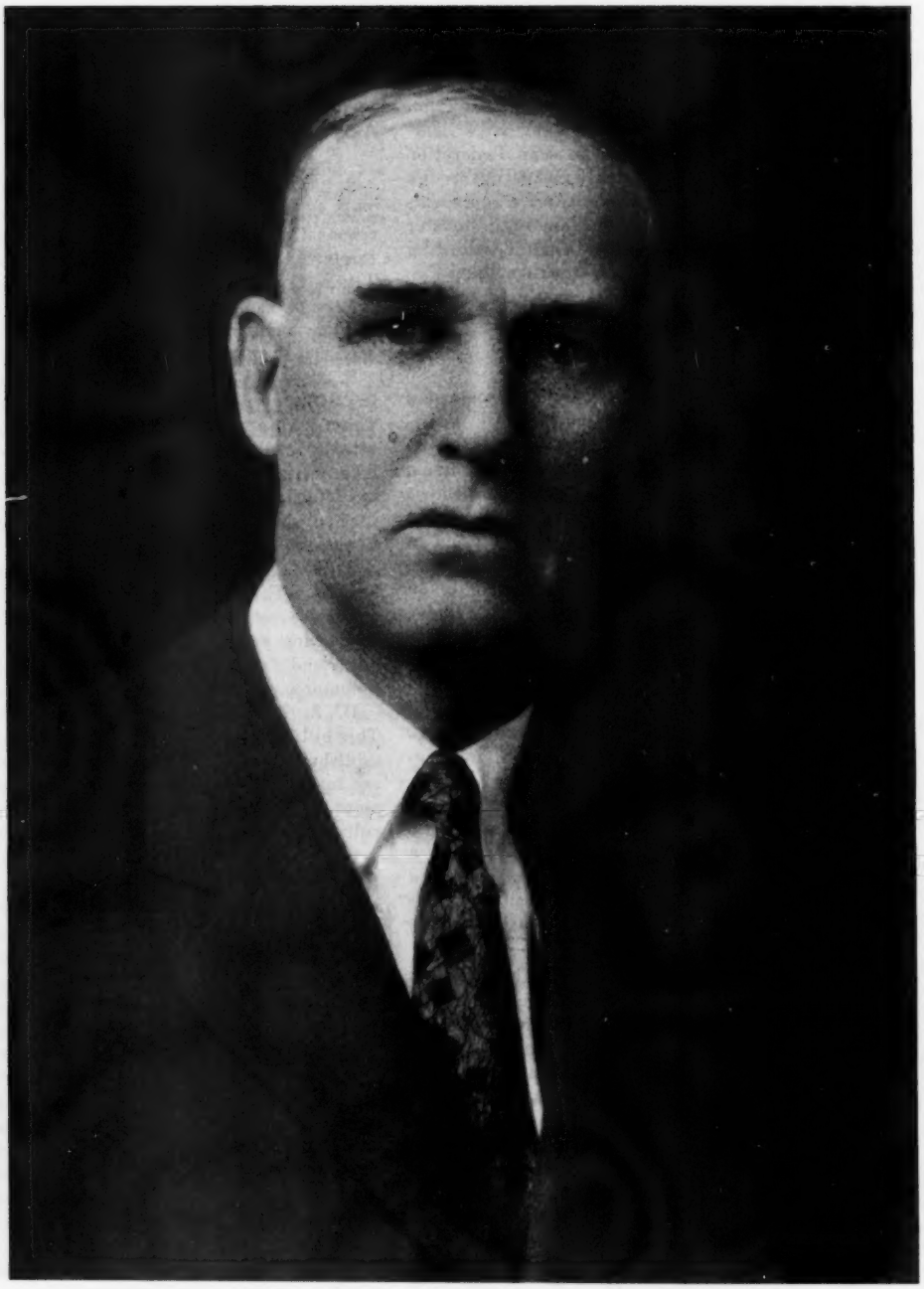
H. J. Res. 166. Mr. Underhill (Rep., Mass.). This resolution provides for the election of Senators by the Legislatures of the States instead of by the people. Judiciary.

Transportation Measures

H. R. 7583. Mr. Hogg (Rep., Ind.). This bill authorizes the construction of a barge canal from Ft. Wayne, Ind., to Toledo. Rivers and Harbors.

H. R. 7700. Mr. Kendall (Rep., Pa.). This bill author- (*Continued on page* 166)

The Union Pacific



EUGENE MCAULIFFE
President,
The Union Pacific Coal Company

Coal Company

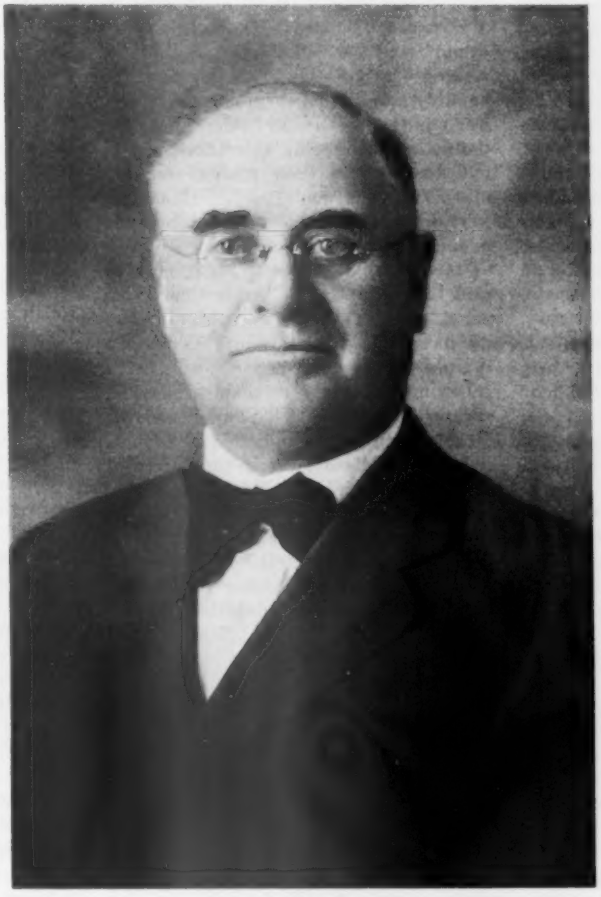
By Eugene McAuliffe*

Modernizing program begun in 1923—Better labor relations established—Paternalism avoided—Mechanization has resulted in increased yearly earnings—Wage scale designed to equalize different classes of labor

THE series of articles which follow, broad in compass, cover very capably the activities of The Union Pacific Coal Company, a property located in the State of Wyoming, whose annual production of bituminous coal approximates 3,000,000 tons. The 20 odd staff officials contributing, enjoy a familiarity with the property and its employes that especially fits them to report every detail that relates to the operation of the properties.

Like the speaker last positioned on an extended program, the writer finds it difficult to find a single remaining phase of operation or management to touch upon; it may, however, be of interest to the readers of THE MINING CONGRESS JOURNAL to know something of the underlying policies that actuated the management of the property, during a period in which, what is perhaps the largest mechanical loading program in a coal mining property, whether located in the United States or elsewhere, was gotten under way. The tonnage loaded mechanically in 1929, will exceed 1,750,000 tons.

The writer came to the property on March 1, 1923, finding 17 mines then in operation, the maximum daily output 16,500 tons, or an average of 970 tons per mine. The property, as American coal properties go, was a rather old one, having produced its first coal in 1868. The 17 mines were all developed by slopes driven in from the crop line, the tipples of wood construction, the mine equipment throughout, except as to an extension of the use of electric power, not much changed during the preceding generation. Unfortunately, the previous managements, perhaps because of limitations placed upon them, continuously perpetuated small mines, narrow track gages (much 30 and 36-in. used), together with correspondingly small pit cars (3,000 to 4,000 pounds capacity). The only material alteration made in the underground mining methods were those of changing from rooms driven from strike entries to the rise, to a panel system with rooms driven on the strike. This change was merely begun in 1923, and while representing a definite improvement in hand loading methods, only added new complications when the work of introducing mechanical loading was begun. This double method of operating within individual mines offered in certain instances a rather spotted situation into which the loading machines were necessarily introduced. While definite progress has been made toward clearing the pillars out of the former hand loading territory, an examination of certain recent mine maps evidences the fact that the process of "mopping up" old territory, will continue to drag along for some years.



GEORGE B. PRYDE
Vice President,
The Union Pacific Coal Company

Any survey of a coal mining situation preparatory to introducing mechanical loading should begin with the labor employed in and about the mines. The theory of "self-determination," while given world publicity following the Great War, is in no sense a new thing to the coal miner. Professor Carter Goodrich, in his interesting and informative book dealing with coal miners and coal mining, has referred extensively to this age old characteristic, using the term "the miners' freedom." This writer said in substance, that the miner, a strong, virile, "danger be damned," individual, doing the best he could under what might be called fortuitious circumstances, was loath to accept new methods of getting out coal, more so when such contemplated the elimination of the tonnage basis of payment. The miner's "place" is, in a sense, his castle. His attitude toward interference is not unlike that expressed by a great English statesman and pleader of the early eighteenth century, who said; "the poorest man may in his cottage bid defiance to all the force of the Crown—the storms may enter, the rain may enter, but the King of England cannot enter." Such in a way expresses the attitude of the experienced coal

* President, Union Pacific Coal Company.

The Union Pacific Coal Company's Headquarters Building, Rock Springs, Wyo.

miner when the employer seeks to invade his room or place.

The coal mine worker, as a class, represents the last stronghold of labor individualism. His life has in the past and in too many instances does yet, run a troubled course. The work is definitely hazardous, but perhaps the most sodden side of existence confronting him and his family is that of the uncertain tenure of mine employment. With this feeling ingrained in his mind and blood, it is not strange that the introduction of machines, presumably bought to take his place, would invoke other than a welcoming attitude.

The overwhelming majority of mine workers employed in the Wyoming mines are men of sterling qualities. Perhaps in no set of mines can be found a wider diversity of racial origin. The Union Pacific Coal Company forces embrace 49 nationalities. Racial animosities are, however, strange to say, non-existent. The unification displayed through their general activities, whether organized or social, is quite remarkable. Our schools, churches and Sabbath Schools are wonderfully supported and attended, and the desire for higher educational advantages for the workers' children, finds continuous expression in all our communities. With this situation in mind, the opportunity to lay a foundation of good will, predicated on the theory that a good workman had certain rights, seemed propitious.

The scale of wages paid in Wyoming were, and are yet, relatively high. All mine labor within the state was, in 1923, as now, organized. Unfortunately, the continuously recurring strikes occurring in the central competitive field had unsettled both operator and mine worker, and as labor could be obtained without serious consideration for the element of continued employment, men were piled into the properties in such number that made it possible, anticipating a strike alarm, to get out a heavy tonnage. The end result of this situation was evidenced in a high percentage of boarding house habitues, a slow turn, much absenteeism, coupled with dissipation, and resultant low earnings for all.

The solution of this problem seemed plain. With a labor turn-over approximating 125 percent annually, reduction of force came quickly when the employment of men ceased. An attempt was next made toward the establishment of a measure of mutual confidence which would tend to eliminate shut-downs, making it possible to increase the monthly and annual earnings of the men. Early in the mechanical loading program, the policy of refusing to release men to put machines in their places, was put into effect, and made public. Machines were introduced only at such times and in such numbers as the natural reduction in forces made possible. So it may be said that The Union Pacific Coal Company's mechanical loading program had its inception in an attempt at human engineering.

During the early mechanical loading expansion period, black powder and the carbide lamp were supplanted by permissibles and Edison electric cap lamps, a program of bath house, school house, and community building construction was carried on, and the various social activities referred to in detail in certain of the staff papers were gotten under way. It would perhaps be appropriate at this juncture to say that the officials of the company neither attempt to lead in, nor control, the social and religious life of our employes; on the other hand, we are definitely committed to the theory that paying workmen in part money and part social privileges is as un-American as it is unsound. Workmen should buy their own amusements and their earnings should contemplate just this situation. Paternalism in any form is objectionable to the great majority of men.

Reference has been made to the fact that the Wyoming mine workers are well organized. The history of organized mine labor in the past 10 or 12 years has not been such as to make friends for the Union. Stripped as it now is of the tremendous power it exerted over the economic life of the nation as late as 1922, and torn by internal dissension, it would not require extraordinary effort to eliminate the Union in the remaining organized portion of the Rocky Mountain Region. Whatever the crimes committed in the past by the Unions, such have in our opinion been fully paralleled in the abuses put upon mine labor by many employers, and with an abiding confidence in the ultimate good intention of workmen as a class, the management of The Union Pacific Coal Company decided to give the Union the widest possible chance to establish itself upon the property, on a business-like basis, asking only that the extreme element that had drifted into the coal mines from the old radical metal mining atmosphere, be shaken out, all theories of "wobbly" propensites to be eliminated. To the end that the Company's theory of relationship might be given the fullest trial, a former President of the United Mine Workers organization, Mr. John P. White, was chosen early in 1929 as Umpire, to arrange the settlement of any differences that might arise between the company and its men. For a coal company occupying a definite fuel supply relation to a great trunk line railway, to place its labor affairs in the hands of a man whose life has been spent in the service of the Union might seem injudicious, but we were willing to take the chance. The arrangement was later extended to cover 90 percent of the state production of coal, the coal operators of Illinois thereafter following the precedent established in Wyoming, the Hon. W. B. Wilson, former Cabinet officer and past Secretary of the Miners' Union, now engaged in adjudicating the differences that arise between employers and mine workers in Illinois.

Commencing with the year 1926, an exact record of working time and earnings of all Union Pacific workmen has been maintained, and while the average daily earning of the men has been reduced by the substitution of day labor for tonnage rates, the reduction in man power obtained by failing to replace separations from the service, has made it possible to increase the monthly earnings of the men. This increase continued steadily up to the date of the wage revision made December 1, 1928, and what is more remarkable, the average earnings of the men employed during 1929 under the reduced wage, has been brought up to a point approximating the earnings made under the previous scale, this in the face of the fact that from 10 to 14 days vacation was extended to the men employed in all but one mine.

The earnings of all men and boys,

exclusive of the official staff, together with working time for the period referred to, were as follows:

Year	Average Days Worked	Average net earnings, all men and boys Per Day	Per Month	Per Year
1926....	208.3	$9.43	$163.76	$1,965.87
1927....	238.5	9.02	171.82	2,064.03
1928....	259.8	8.60	186.23	2,234.76

The wage scale was modified on December 1, 1928, otherwise the rates paid were uniform throughout the three-year period. The figures for the year 1929 are not as yet available.

Comparisons, whether in or outside of the mining industry, are "always odious." Under the hand loading scale, certain classes of men paid on a tonnage basis were enabled to earn abnormally high rates of pay. This situation found expression in the form of pay checks that ran 200 percent and upward of the amount earned by the men paid on the day wage basis. In addition to the increased measure of affluence enjoyed by the tonnage men, they could, while keeping their income at a high point, afford a greater measure of absenteeism than could the day worker. With the same general cost of living, the same desires for amusement, the education of their children, etc., this disparity in earnings between men living in adjoining houses bred discontent. The equalizing effect of a 60 percent translation from hand to machine loading brought about a substantial leveling effect between our men employed in the various tasks. The measure of time worked by the seven general classes of mine labor with their average monthly earnings for the year 1928, shown below:

Occupation	Average Days Worked	Average Net Monthly Wage
Machine runners and helpers	264.1	$200.52
Miners and loaders	212.5	186.90
Haulage men	276.3	178.00
Timbermen and trackmen	283.9	184.57
General inside	277.8	183.62
Surface men	312.9	189.06
General outside men	309.5	189.61
Average all men	259.8	$186.23

It will be noted that the spread in working time runs from 20 percent above to 18 percent below the average of all men, while the spread in monthly earnings ranges from 7.6 percent above to 4.4 percent below the average of all men. With the transition stage passed, we anticipate an even better equalization of earnings and working time.

There are certain classes of mine labor that deserve a wage above that paid to men in less hazardous, less arduous and less responsible positions, but the old basis which yet obtains in many hand loading mines tends to create an artificial aristocracy for a portion of the workers, while the others are given a wage that, while comparing favorably with rates paid in the skilled trades, is definitely below that paid to the tonnage men who are their immediate neighbors and associates. No branch of society will keep happy and wholesome where a caste system exists.

In the making of the last wage agreement, provision was made for the formulation of rates of pay to men employed in the operation of loading machines, either on a "tonnage or a combination of tonnage and day wage basis," such special agreements to be arrived at between the individual operator and his men, and to apply only to the mines and classes of machinery covered by the new agreement. It is the belief of our management that with adequate data of past performance available as a basis, a combination rate can be developed that will not only increase the earnings of men employed in mechanical loading, including the operation of cutting machines and electric drills, but which will also increase the average daily output for each machine employed.

The progress made toward stability of employment and a reasonable annual earning with a substantial decrease in mine cost has been brought about, not only by the introduction of coal loading machinery, but likewise by the following:

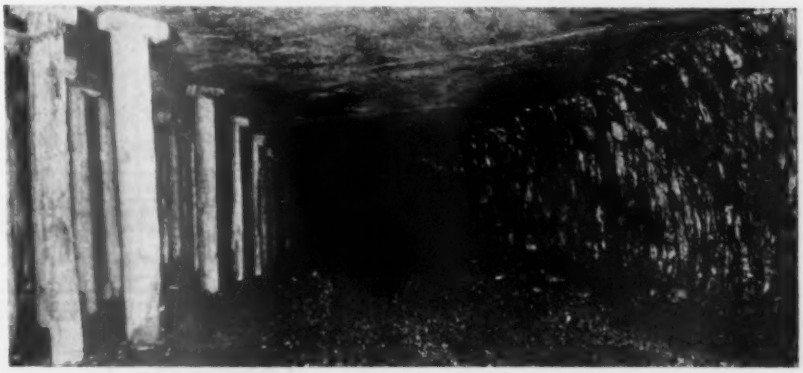
(a) Discontinuing the practice of storing railway fuel during the fall and winter peak demand period previously made necessary by actual or threatened suspensions, this situation possible with a composed labor supply.

(b) The production of a certain tonnage of coal for storage purposes during the period of low railway fuel demand, April to July, inclusive; this coal transported to destination by the railroad when coal cars are plentiful, is taken up and used during the peak demand period when transportation demands are heaviest.

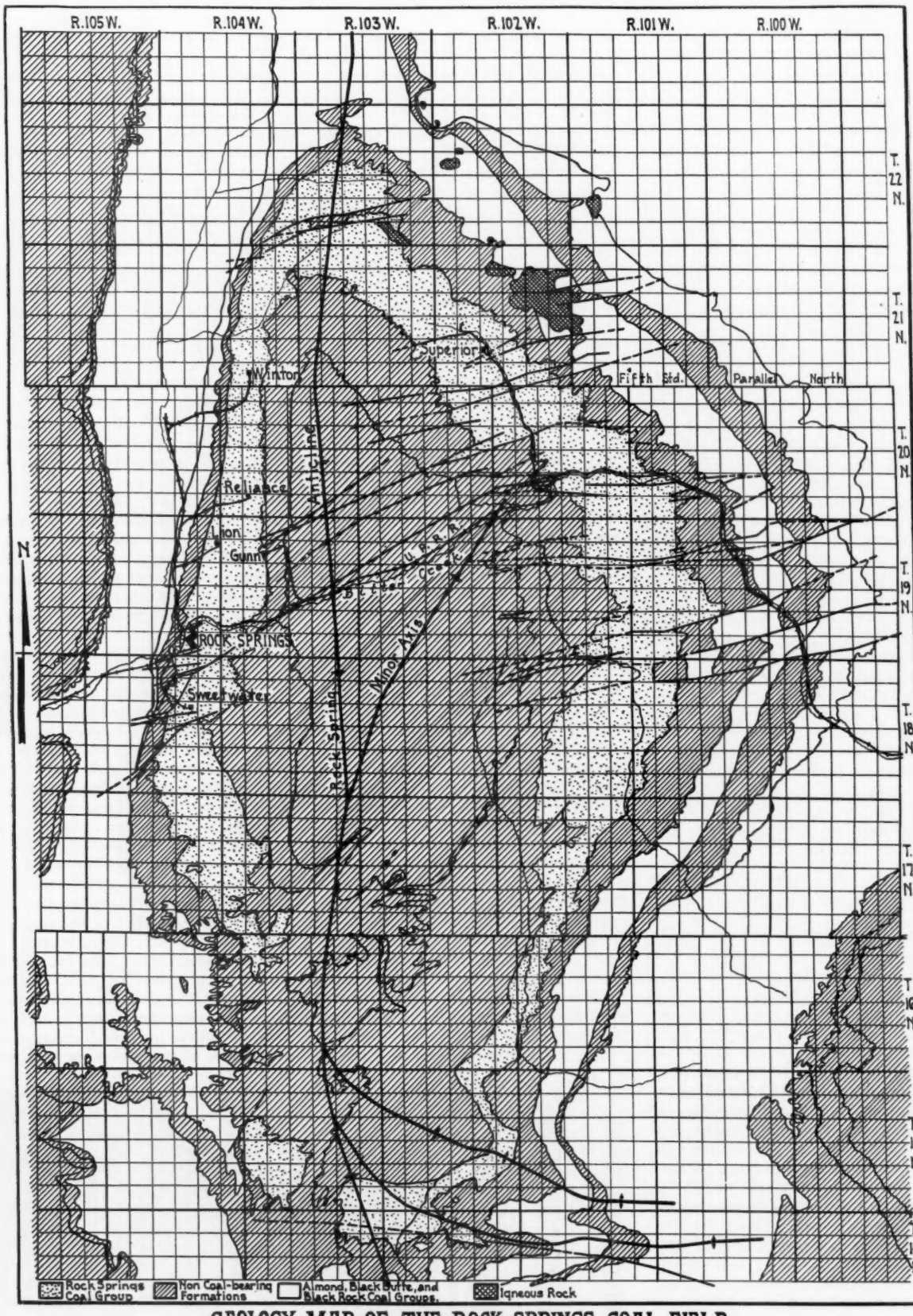
(c) The concentration of all construction work in and about the mines during the dull season, with loading machines in part, taken off room and long face work, and used to push development work as far as possible during the dull season.

Some 30 years ago, a railway superintendent named Brown, served a small eastern line, The Fall Brook Railway. In that day, railroads and railroad employes were rather a mixed lot. The theory of "hire and fire" was uppermost in the minds of the men in charge of operation, as well as with the trainmen, enginemen and shop men. Laborers got a dollar for 10 hours and were without social status. Superintendent Brown had humanitarian instincts, coupled with sufficient vision to discern that the continuous shifting of men was not only costly, but that it likewise stood in the way of better service. Mr. Brown evolved what was known as the "Brown System of Discipline," a system of merit and demerit marks used in lieu of suspension and discharge. The plan spread, until today it is substantially universal on the railroads of the United States and Canada. Superintendent Brown is dead, many younger railway employes never heard of him, but the theory of using "Brownies," "goes marching on." Perhaps only a few railway executives ever think of the "Brown system" as marking the beginning of the changed dispensation which has placed the railways at the top of all American industry; such, however, is the case.

The railway industry and the coal industry are insolubly related. Not because the properties in our charge belong to a great railroad company, but rather because of the example set by the railroads as a whole, we have attempted to think of coal mining and coal mining labor problems as quite as amenable to the application of business vision, rigid integrity and a just recognition of the fears as well as the hopes and aspirations of every employe, such as was found to be the case by the railroads. Men have come to visit our properties from every coal mining field in Europe, Asia, Australia, Canada, Mexico, and the United States. They have said many kind things about us, most of them undeserved. We ourselves well know that the road toward betterment is long and rough; we are, however, trying to put a milestone or two behind us each year.



Longwall face at No. 8 Mine, Rock Springs, Wyo.



GEOLOGY MAP OF THE ROCK SPRINGS COAL FIELD

Taken from U.S.G.S. Bulletin 702

FIGURE NO. 1

The GEOLOGY of the Rock Springs Coal Field

Topographic features—Geology of field with charts showing cross section of coal formations—Description of seams

By C. E. SWANN *

THE ROCK SPRINGS uplift is located in the south central part of Sweetwater County, Wyoming, and the developed portion of the Rock Springs Coal Field occurs in the northern end of the uplift. This part of the field was made the subject of a geological study and a part of the area subdivided during the summer of 1907 by Geologist A. R. Schultz and party. Topographic locations as well as line measurements were made by stadia: coal outcroppings and prospect pits were located carefully, and reliable geologic and topographic maps have been published by the Government which are of great assistance to anyone interested in the coal or oil and gas developments of this region. The map and cross section of the Rock Springs uplift used with this article are reproduced from U. S. G. S. Bulletin No. 702.

TOPOGRAPHIC FEATURES

The field here considered is the northern rim of the Baxter Basin Oil and Gas Dome which is completely surrounded by Tertiary beds. Within the field the principal topographic features are due to (1) hard resistant sandstone of the Mesaverde; (2) hard resistant limestone and sandstone of the nearly horizontal Green River and Wasatch formations; (3) migrating sands; (4) soft beds of the Wasatch, and (5) igneous rock.

The hard, resistant sandstone of the Mesaverde forms a concentric ring of hills, more or less continuous about the central portion of the Rock Springs or Baxter Basin dome. These concentric ridges contain the most important coal beds of the field and are usually separated from each other and from areas of equal or more elevated younger rocks by belts of low relief. The two most pronounced depressions are carved in the soft shale overlying and underlying the Mesaverde sandstone. The low valleys are natural routes of travel and afford easy access from the railroad to the more rugged ridges containing the coal. The shale below the Mesaverde gives rise to low relief along the central part of the Rock Springs dome.

The hard, resistant limestones of the Green River and Wasatch formations produce a topography noted for its table-like forms, bounded by prominent escarpments occurring in regular benchlike succession, giving a characteristic bad land impression.

Huge sand dunes formed by the migrating sands are the most conspicuous topographical feature in the northern part of the field. The soft beds of the Wasatch form a low depression along the synclinal trough of the Great Divide Basin. This formation contains numerous beds of coal, few of which are well exposed. The topographic features are such that the coals are readily accessible.

In this field igneous rocks rise like land-marks above the high mesa surrounding the Superior mining district on the north. The lava forming these rocks flowed from a little group of volcanoes far removed from similar centers of igneous activity. These concentric cones, needle-like necks, irregular dikes, and table-like sheets afford a striking contrast to the topographic features of the surrounding hills, and during recent years serve as guide monuments to airplane travel across this barren region.

Bitter Creek, the only prominent stream in this field, flows across the central part of the field at nearly right angles to the central axis of the Rock Springs Dome, carrying this district's drainage toward the Pacific Coast. The stream has carved out a broad valley, along which the Union Pacific Railroad was constructed. The Union Pacific Railroad gives a direct outlet east and west for the mineral deposits of the Rock Springs dome.

STRATIGRAPHY

(*From U. S. G. S. Bulletin No.* 341.)

The fossils collected by A. R. Schultz and party, during the 1907 work in this field and studied by F. H. Knowlton and T. W. Stanton, indicate the formations have the following geologic time value:

Tertiary Formation

Three hundred and fifty feet Green River sandstones, unconformity, 600 ft. of shales and limestones of Green River formation (most important spring horizon), contains some coal; unconformity, 400 to 825 ft. variegated clays, shales and sandstones. Twelve hundred to 2,650 ft. Wasatch formation containing the Black

Rock Coal group. Prolifically coal bearing with many thin beds of coal and at least one bed 25 ft. in thickness. Yields artesian water. Flowing well at Bitter Creek. Unconformity.

Cretaceous Formation

Two thousand three hundred and seventy-one feet of Laramie formation (?) containing the Black Buttes coal group of numerous important coal beds, none of which are being developed at the present time, 750 ft. of Lewis shale, non-coal bearing Mesaverde divided into Almond coal group, 900 ft., in which coal has been mined at Rock Springs and Point of Rocks, 800 ft. of massive white and yellowish sandstones yielding artesian water in parts of the field; the Rock Springs coal group, 2,400 ft. thick, containing the best coal in the Rock Springs field. Important mines are operating the Rock Springs coal group at Rock Springs, Quealy, Lionkol, Reliance, Dines, Winton and Superior. Artesian water zone, bottom member 2,350 ft. drab, yellow and brown sandstones, and interbedded shales in which massive sandstones are grouped near the top giving rise to the "Golden Wall" surrounding Baxter Basin oil and gas field.

The oldest coal bearing rocks exposed in this area are of Montana Age. In gas wells drilled in the northern end of

* Chief Engineer, The Union Pacific Coal Company.

Cross Section of Rock Springs Coal Field along line one mile north of Fifth Standard Parallel North
Taken from U.S.G.S. Bulletin 341

FIGURE NO. 2

Baxter Basin thick seams of coal have been cut in the Frontier formation of the Colorado group at depths ranging betweeen 3,500 and 4,000 ft. These seams are probably of similar character to the coal found in Uinta County in the vicinity of Kemmerer and Cumberland.

Rock Springs Coal Group

The Rock Springs coal group is the most important and the one containing the highest grade of coal in this area. Its basal portion consists of heavy, ridge making coal, bearing sandstones and the remainder of brown, yellow and white sandstones, shale, clay and interbedded coal. The group is prolifically coal bearing throughout, containing over one hundred seams, varying in thickness from 1 to 18 ft., of which at least twelve beds are over 5 ft. in thickness in some part of the field. These beds occur somewhat regularly throughout the group and are fairly persistent along the strike. They have been prospected along the outcrops from the town of Quealy (old Sweetwater) through Rock Springs along the rim to the town of Superior. Only a small amount of prospecting has been done south of Superior on the east rim due to the thinning out of the seams which make them unattractive for mining purposes at the present time. This coal is, however, of high grade and will undoubtedly be mined at a future date.

The Union Pacific Coal Company operates mines at Rock Springs, Reliance, Winton and Superior, producing coal for railroad use only, while commercial mines are being operated at Quealy, Rock Springs, Lionkol, Dines and Superior. The first mines of any size were opened in this field during 1868 and the present annual production of the district is approximately 3,500,000 tons.

The coal beds dip away from the rim from almost level to 20 degrees. The workable coal extends back from the surface outcrops from one to three miles or until the cover becomes too heavy to permit of economical mining. There are six seams of workable thickness at the town of Rock Springs, known locally, in order of their occurrence as Seams 5, 3, 1, 7, 11 and Van Dyke. The question naturally arises, "How did the workable seams acquire their names?" Original mines Nos. 1 and 2 were opened on the third workable seam below the top of the series and this seam became known as No. 1 Seam. No. 3 Mine was next opened on a seam above No. 1 and the seam became known as No. 3 Seam. No. 5 Mine was opened on a seam above No. 3 and this seam became No. 5 Seam; No. 6 Mine was opened in one of the lower seams of the Almond series and this seam is known as No. 6 Seam; No. 4 Mine was next opened on No. 1 Seam and the next mine opened was No. 7 on a seam below No. 1 Seam and this seam became No. 7 Seam. The Union Pacific Coal Company Mines 8, 9 and 10 have since been opened on No. 7 Seam. About 1868 the Van Dyke mine was opened up on a seam some distance below No. 7 Seam and this seam is known as Van Dyke seam.

An attempt to number consecutively the workable seams below No. 7 Seam has been made but this is difficult of accomplishment because seams workable in one locality become thin or dirty and unworkable in other localities while seams too thin to be workable in one locality thicken and become workable in other sections of the field. The workable coal occurs in lenses and a nice engineering problem is presented in determining the proper location for point of development of a new property due to topographic features and the heavy expense involved in properly diamond drilling the proposed workable area. During the past forty years a large amount of surface prospecting has been done along the different outcrops and numerous drill holes have been drilled to the different seams to determine where the seams are workable, but additional drilling sometimes completely changes our ideas concerning a specific coal property.

An ideal geological section showing the relative position of the workable seams in the Rock Springs series taken just north of Rock Springs (sketch III) is presented to give a graphic illustration of the coal measures. Coal seams under 5 ft. in thickness are not considered economically workable in this locality at the present time, due to distance from market, and to the fact that a number of seams much (*Continued on next page*)

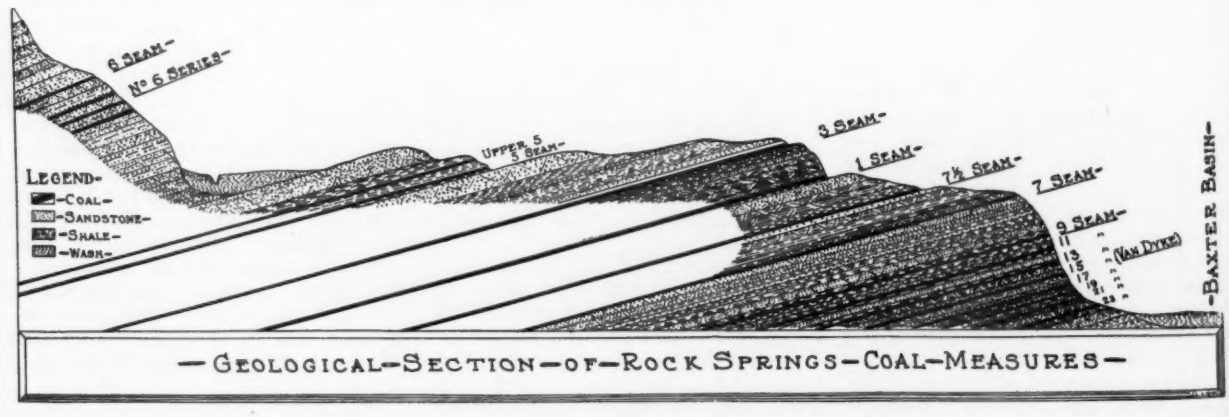


FIGURE NO. 3

Footprints of PREHISTORIC DINOSAURS

Footprints made a million years ago are plainly marked in roof strata at Superior and Reliance Mines—Interesting evidence of prehistoric animal life

By C. E. SWANN *

DURING Triassic times, when mammal-like reptiles had begun to wane, there arose a race, the Dinosauria, which in their way, were just as perfectly adapted for easy and even rapid progress on the land. These became both the dominant reptiles and the dominant land animals of the late Triassic, the Jurassic and the Cretaceous periods, a stretch of time which may with equal truth be called the "Age of Reptiles" or the "Age of Dinosaurs." The dinosaurs had a common ancestry with the crocodiles. The distinctive feature of the order was a bipedal gait. This determined many of the other structural peculiarities. With the whole weight of the body thrown upon the hind limbs the attachment of the girdle to the backbone had to become greatly strengthened. There is little doubt that dinosaur footprints embedded in the overburden of the coal seams at Superior and Reliance indicate the animals walked on their hind limbs.

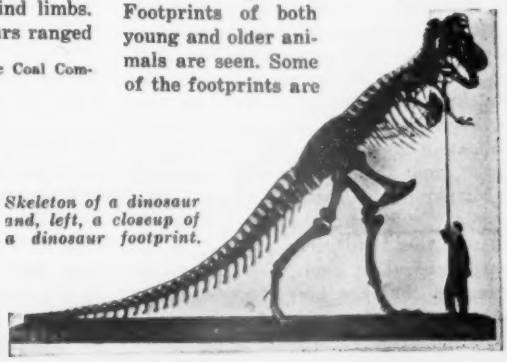
The primitive horned dinosaurs ranged at least from New Mexico northward to Canada. They were peaceable plant-eaters and obviously needed protection from their enemies, the carnivorous dinosaurs. Hence the head was armed with horns, the neck was protected by the bony frill or shield, and the body was covered with a tough, scaly hide. These were the ancestors of the Triceratops, which roamed the western plains at a later time.

In the late Cretaceous or early Tertiary Age a group of reptiles (Triceratops), which were contemporaries of the huge carnivorous dinosaur, roamed the western plains and we are reasonably certain the huge carnivorous dinosaurs inhabited the Superior and Reliance districts of Wyoming because their tracks are plainly visible in places in the roof strata of the Superior and Reliance mines. These tracks are very similar to those of a huge bird. Footprints of both young and older animals are seen. Some of the footprints are about 12 in. in diameter while others are from 24 to 30 in. in diameter and 36 in. long (see illustration), these prints extending downward from the sand shale roof and into the coal as it was in place (see illustration). The stride of these animals was about 10 feet long, indicating a monstrous creature, and we are told some attained a length of 50 feet, a height of 18 ft., had jaws 5 ft. long, armed with long, sharp teeth adapted to tearing flesh.

In the late Cretaceous period dinosaurs roamed everywhere, big lumbering creatures as big as many elephants, wading in the streams and lakes, feeding on water plants, smaller dinosaurs stalking by the water side or splashing into the water and swimming hastily away upon the approach of some flesh-eating dinosaur looking for his dinner or supper and little dinosaurs scurrying out of the way.

Until 1877, although many fossil remains of prehistoric dinosaurs had been examined by eminent geologists and others, no attempt at restoration of a complete skeleton had been made, and Professor O. C. Marsh is credited in some sources as being the first to partially assemble the fossil remains of the dinosaurs.

In general, it may be said that the Tertiary period was ushered in by a world-wide revolution. Seas changed places and mountains arose where sea water had been. Whole races of animals were obliterated and new races took their places. Whole floras, or groups of plants, disappeared and new floras appeared. It was during this period that the dinosaur disappeared.



Skeleton of a dinosaur and, left, a closeup of a dinosaur footprint.

GEOLOGY OF ROCK SPRINGS COAL

(Continued from preceding page)

thicker are available for development. Rock Springs coal acquired its reputation on the commercial market from coal mined from No. 1 Mine, but coal mined from several of these seams gives satisfaction on the commercial market.

No serious attempt has been made to accurately determine the total amount of workable coal in this field as it would entail an enormous amount of diamond drilling and outcrop prospecting to obtain sufficient data to properly calculate same, but enough information is available to demonstrate the fact that only a small percentage of the coal resources has been extracted, and that enough coal reserves exist for the continued operation of mines over an indefinite period.

* Chief Engineer, The Union Pacific Coal Company.

HISTORY of Union Pacific Company's MECHANIZATION

Early hand methods—Introduction of cutting machines and electric haulage—Mechanical loading as employed in thick coal—Loading machines, conveyors, scrapers, and pit car loaders now used—Development of McCarty Duckbill—Summary of tonnage and equipment investment 1923 to 1929

By A. W. DICKINSON *

IN THE YEAR 1868, the transcontinental railroad construction program, deemed so important by the United States Government and by the people of the Pacific Coast and of the more thickly populated territory east of the Missouri River, was brought to successful culmination in the joining of the tracks at Promontory, Utah. The Union Pacific Railroad, building west from Council Bluffs, Iowa, and the Central Pacific Railroad, building east from Oakland, Calif., had pushed their lines over hundreds of miles of non-revenue desert territory in order that the only recently acquired territory of the Pacific might be bound to the United States of America for all years to come.

Early in the projection of the plan for a transcontinental railroad, the necessity of an adequate fuel supply was recognized and the reports of coal occurrence in Wyoming, included in General Fremont's reports of earlier date, received the consideration due to their importance. The potential fuel supplies indicated by the coal outcrops were important factors in the determination in location of the route of the railroad. At the points later identified as Rock Springs, Carbon and Almy, coal mines were developed, the work necessarily being a hand operative job.

With the limited knowledge available, in the mountain area at that time, the early mining was extremely simple. At a later period steam driven hoists, fans and pumps were introduced, particularly as the slopes progressed to the dips following the pitch lay of the coal. The work of the earlier days was performed largely by English speaking miners, but, as the comforts of the mining locations were meager, the increasing demand for coal resulted in a shortage of labor. This shortage was met by the introduction, into the mines, of Chinese brought on

after the completion of construction work on the Central Pacific Railroad. For many years the Chinese carried on under the direction of the English and American mining men and only in the last few years have these picturesque workers faded from the scene.

The first successful step in replacing the hand mining came through the introduction of compressed air undercutting machines of the reciprocating type. With the increasing length of haul came the electric locomotives and accompanying the use of electric power came also the realization of the superiority of electric power from the transmission viewpoint as compared with compressed air. Electrically driven undercutting machines followed this realization, paralleling the practice of other coal fields in eastern states, in that the breast machine was the pioneer, followed by the short-wall machines. Electric driven motor drills, for the placement of shot holes in the coal, arrived with the electric coal undercutting machines.

While the laborious task of undermining the coal through the agency of picks, wielded by hand, had been in a large measure solved, the heaviest work of all remained an untouched problem. Coal was still being loaded through the agency of the hand shovel. Thousands of men shortening their lives, particularly in the high mountain altitudes, in an endeavor to gain a livelihood. The mechanical loading of coal, in the underground workings, first received attention at the Hanna property in southern Wyoming. In the Hanna mines the thick bed of coal, 32 ft. from foot to hanging wall, on a 17-degree pitch, prompted the thought of employing boom and dipper stick types of shovels powered by electric motors. These shovels required 28 ft. of width and 18 ft. of height to permit of operation, but such was the nature of the coal deposit that the shovels were given freedom of room for operation and hence in 1914 this loading practice was inaugurated. Continuing on to the fall of 1923, Hanna increasingly felt the difficulty of projecting development work with a rapidity sufficient to keep working places for the shovels and in December, 1923, two Joy 4-BU loading machines were placed in operation, for the duty of driving the "first mining work" for the large shovels. The habit of single shift work in the 24-hour period of each day was still prevalent over the coal fields of the United States and had its influence in the development problem at Hanna. In April of 1924, two more Joy 4-BU loading machines were placed in operation and the results closely watched for the balance of the year.

As the performance of the mechanical loading equipment became apparent, the discussion of the trend toward mechanical loading, in southern Wyoming, grew

* General Superintendent, The Union Pacific Coal Company.

in importance and resulted, in the early part of January, 1925, in the decision to investigate further. In carrying out the investigation an operating engineer was sent east and in January and February of 1925, spent thirty days in observation. The problem at that time was:

(1) To seek a loading device or machine which would best carry on and meet the need at Hanna.

(2) To seek devices applicable to the lower coal and varying band rock and roof conditions of the Rock Springs Field, where pitches vary from 4 to 17 degrees.

The study of the various loading devices was carried on in Missouri, Illinois, Indiana, Ohio, Pennsylvania, West Virginia, Virginia and Kentucky. In passing, it is of interest to note that during this period of observation information was received concerning certain shaking conveyors in use in the anthracite region of Pennsylvania. These conveyors had been manufactured in the United States as the result of studies made by American Engineers while in Germany and Great Britain. This information was considered and discussed by the staff of The Union Pacific Coal Company in Wyoming, but it was not realized, at that time, early in 1925, that such conveyors had a place in the Wyoming plans. The report of the observations, made on mechanical loading devices, in the eastern states, was carefully studied and discussed by the Wyoming Staff and resulted in the decision:

(1) To place more Joy 4-BU loading machines at Hanna, Wyo.

(2) To build a large scraper for trial at Rock Springs.

In April, 1925, the trial scraper was placed in service underground in a laboratory area dedicated to research. This device continued to load coal for over a year, developing information on the problems of roof span, timbering, sheaves, sheave anchorage, rope, cutting of coal, shooting of coal and much tributary detail. Soon after the installation of the trial scraper a complete unit was ordered from the Goodman Manufacturing Company of Chicago, installation being made as of February 1, 1926. The operation of this 125-h. p. unit resulted in the placement of seven additional scrapers in April of 1926.

Turning from the scrapers, for the moment, and returning to July, 1925, in order to allocate the chain of events, we find that at that time discussion was revived on the shaking conveyor. An American Engineer was considering the agency for a German-made conveyor and planning an inspection of these devices in German mines. In the event his observation of the conveyors in Germany resulted in approving the device, the

Seven hundred and more years of brain stunting toil

opportunity was offered American clients to purchase shaking conveyor units through the American Agency. In the literature, setting forth the appearance and manner of use of the German shaking conveyors, appeared an extensible pan to be used at the face end of the conveyor. The device was shown as in use in a potash mine in Germany. The sides of the lower and upper pan were drilled at approximately 6-in. centers and through the use of bolts the pans were held together. If it was desired to extend the upper pan, the bolts were removed, the pan shoved out until holes were brought to a match position and the bolts replaced. From the consideration of these extensible pans it was but a brief thought to the conception of a similar pan which might be made to feed forward or be retracted rapidly.

In October, 1925, the first Eickhoff Shaking Conveyor unit arrived and was placed underground at Superior, Wyo. The first service was in driving narrow work up the pitch, shooting the cuts of coal on to the extensible pan and making rapid progress thereby.

The proposed rapidly feeding duckbill was discussed at length and the trials of many devices to accomplish this end followed. Among the attempts may be mentioned the feed sprocket and chain taken from a well known type of undercutting machine. This sprocket was operated first through the agency of a hand crank, next by means of a ratchet, similar to the common drilling ratchet, and again by a 1½-h.p. electric motor. In another of the mining fields, the extension of the pan was attempted through the agency of a feed screw similar to that used on a lathe. This was followed by the development of the sprocket wheel and rack bar device, known as the "McCarty Duckbill." The last named device embodied the virtue of using the reciprocating movement of the conveyor for the advancement and retraction of the upper pan, and it is this feature which has made the later duckbills successful.

At the time of the development of the McCarty duckbill, another useful device for conveyor operation was developed and brought into being. This was the swivel, by means of which the duckbill could be operated radially, so that through its use a wide room face might be loaded out.

In the meantime, the matter of providing development for the scraper loaders had become a pressing problem and the realization of the value of the shaking conveyor and duckbill resulted in the placement of orders for additional shaking conveyors. Continued use of this equipment, following the purchase of many additional units, brought the realization of its application in development for wide work and for pillar withdrawal. Time has brought improvements in the detail of construction; the ratchet or control device has changed, as has the rack pan, otherwise known as the feed pan, and the shovel.

In January, 1928, the Joy 4-BU loading machines at Hanna were replaced through the purchase of the modern Joy 5-BU machines. Twelve 4-BU machines were replaced by seven 5-BUs. In the meantime, the practice at Hanna had embodied the use of the large Vulcan two-drum scrapers in the lower

The shaking conveyor does well under bad roof conditions and in close timbering

levels of the mines where spalling ribs made the operation of the Thew and Joy machines hazardous. The driving of the long planes up the 17-degree pitch has been taken over by the shaking conveyors and duckbills. A new adaptation, known as the Button Conveyor, has been introduced to bring the coal from the discharge of the shaking conveyors down to the level, from which the plane development is started. The Button conveyor is an underground adaptation of the retarding conveyors used in Kentucky and West Virginia, to bring coal from pit-mouth to preparation plant.

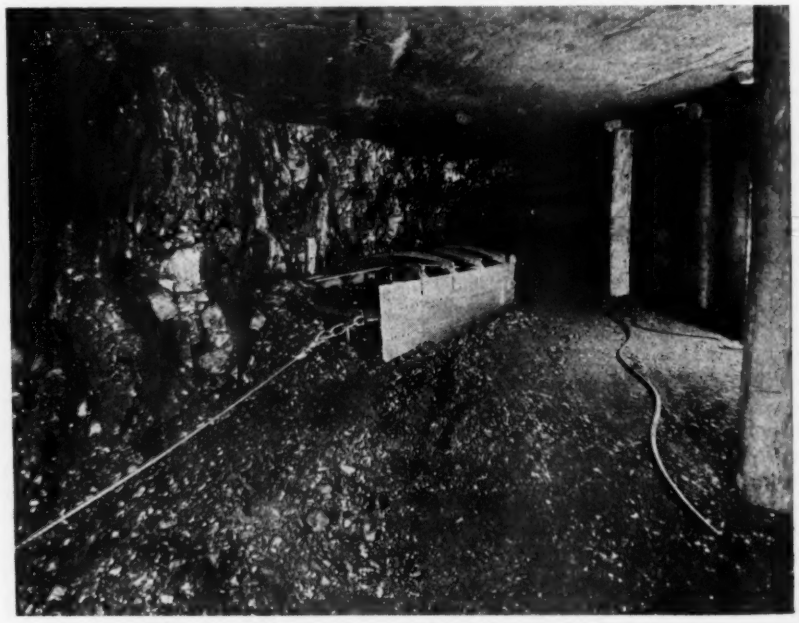
Due to the frequent faults encountered at Hanna it is necessary to drive a great deal of rock tunnel work. For loading muck in the rock tunnels, the Butler compressed air shovel was introduced in 1927. In this connection occurred the problem of sinking slopes in coal varying in pitch from four degrees to 17 degrees. Several hundred feet of slope sinking was done by the Butler shovel, but inasmuch as this required the transmission of compressed air, the Butler shovels are now assigned to rock tunnel work only, where compressed air is essential for the drilling of shot holes. Slope sinking has been carried on through the use of the old Joy 4-BU and also through the use of pit car loaders, of the Northern and Jeffrey Manufacturing Company type, such as are now used so extensively in the coal fields of Illinois. The sinking problem is unsolved at the present time and additional research can undoubtedly be made with profit.

In changes of operation so considerable as to have taken 60 percent of the loading from hand shovelling to mechanical devices, it will instantly occur to people familiar with coal mining in the United States that the workers of the mines, the labor, must have played an important part. This is true in no less measure in the mines of The Union Pacific Coal Company than in the other coal fields of the continent. When we entered upon the introduction of mechanical loading devices, it was realized that the workmen of the mines would feel that many of their body would be displaced. The announced policy which has been carried out, painstakingly and carefully, was and is that no mine workman shall lose his opportunity to earn through the introduction of mechanical loading devices. It was possible to do this because of the practice enduring for many years of filling up the mines in the early fall with floating labor for the winter run. This labor automatically departed in the spring, of their own free will, to be employed on roads, in the harvest and other open air work. In the spring of 1926, 1927 and 1928, when the floating labor departed no men were employed to fill their places and no additional men were employed for the fall run.

It has been observed that the attitude of the workmen has been somewhat negative toward the larger and more complicated types of machines and that they more readily accept the pit car loader and conveyor types. One of the chief reasons for this attitude, it is believed, is because the workmen grasp easily the use and performance of the simpler type of device. Ultimately they carry on very nicely with all of the machines, including the more complicated types. Today the majority of the men own automobiles and use labor saving devices in their homes. This plays its part.

Summary

From the fall of 1923 to the fall of 1929, six years have passed, during which the mechanical loading program has carried on to the status indicated in the accompanying tabulation. The outstanding thoughts, as the result of the past six years experience, occur as follows:



The trial scraper, home manufactured, in the laboratory area

(1) The safety of the men, which is the first consideration, is better cared for when they are working with the mechanical loading devices under the immediate supervision of properly qualified foremen.

(2) It is not necessary to change the mining method, that is to say, the room and pillar, longwall, or other method in use. There are plenty of machines for loading coal. Find the machine best adapted to the method of mining by which the property is being worked.

(3) In planning the development and operation of a new mine where the characteristics of the coal bed are known, there now is sufficient information, based on experience available, to enable one to proceed properly.

(4) Mechanical loading permits of a gratifying concentration of producing territory.

(5) Haulage, while it must be good, is simplified, as are also ventilation, drainage and the furnishing of supplies to the face (very important).

(6) Economies in timbering are an important adjunct to mechanical loading.

(7) Morale of labor is much improved under mechanical loading conditions. Men work together in gangs and they feel better.

THE UNION PACIFIC COAL COMPANY

Number of Employes, Total Tons Mined and Tons Loaded by Mechanical Loaders
Total Investment for, and Present Value of Mechanical Loaders for the Years 1923, 1924, 1925, 1926, 1927, 1928 and 1929.

	1923	1924	1925	1926	1927	1928	1929
1. Total number of employes*	3,034	2,770	2,486	2,241	1,915	1,838	1,845
2. Percentage, using year 1923 as 100 percent	100	91.3	81.9	73.9	63.2	60.7	60.8
3. Decrease in number of men (total)	.....	264	548	793	1,119	1,196	1,189
4. Yearly decrease in men	.....	264	284	245	326	77	7†
5. Total coal loaded (system)	3,241,104.85	2,821,677.80	2,779,064.54	2,776,245.45	2,750,430.20	2,927,390.00	3,060,632.25
6. Mechanically loaded coal (system)	107,693.00	161,245.00	265,432.00	601,611.15	1,107,775.85	1,501,578.00	1,774,279.65
7. Percentage of mechanically loaded coal	3.2	5.7	9.6	21.7	40.3	51.3	58.0
8. Cumulative capital expenditure for mechanical loading machines‡	$41,705.23	$53,236.32	$89,372.25	$205,991.44	$327,155.18	$429,255.72	$482,635.17
9. Present value mechanical loading machines (depreciated)	$23,349.77	$28,434.68	$34,026.19	$144,742.48	$217,410.69	$259,232.97	$245,392.61
10. Yearly purchase of new loading machines	$11,427.22	$11,531.09	$36,135.93	$116,619.19	$121,163.74	$102,100.54	$53,379.45
11. Capital expenditure per ton of mechanically loaded coal (8÷6)	$.387	$.330	$.291	$.343	$.295	$.286	$.272
12. Investment, present value per ton of mechanically loaded coal after depreciation (9÷6)	$.217	$.176	$.128	$.241	$.197	$.173	$.138

	1923	1925	1927	1928	1929
Equipment purchased	2 4-BU Joys 4 Thews‡	8 4-BU Joys 1 Eickhoff	2 Butler shovels 7 M & C conveyors 6 5-hp. Eickhoffs 5 15-hp. Eickhoffs 12 25-hp. Eickhoffs	5 5-BU Joys 12 25-hp. Coscos 1 Jeffrey pit car loader 5 Northern loaders	2 5-BU Joys 6 25-hp. Coscos 16 Northern loaders 1 Vulcan shaking conveyor
	1924	1926			
	2 4-BU Joys	7 Vulcan scrapers 1 Goodman scraper 6 Eickhoffs			

* Exclusive of General Office.
† Increase over 1928.
‡ 4 Thew shovels purchased prior to 1923 included.

LOCATION OF MECHANICAL LOADING UNITS AS OF SEPTEMBER 30, 1929.

	Rock Springs	Reliance	Winton	Superior	Hanna	Total
Goodman	1	..	..	..	..	1
Vulcan (scrapers)	4	..	1	..	2	7
Vulcan (shaker)	..	..	..	1	..	1
Eickhoff	11	1	2	14	2	30
Cosco	4	2	12	..	..	18
Mavor & Coulson	..	..	..	7	..	7
Northern	12	3	..	6	..	21
Jeffrey	..	..	..	1	..	1
Joy 4-BU	..	..	7	..	..	7
Joy 5-BU	..	..	..	..	7	7
Thew	..	..	..	..	3	3
Butler	..	..	..	..	2	2
Total	32	6	22	29	16	105

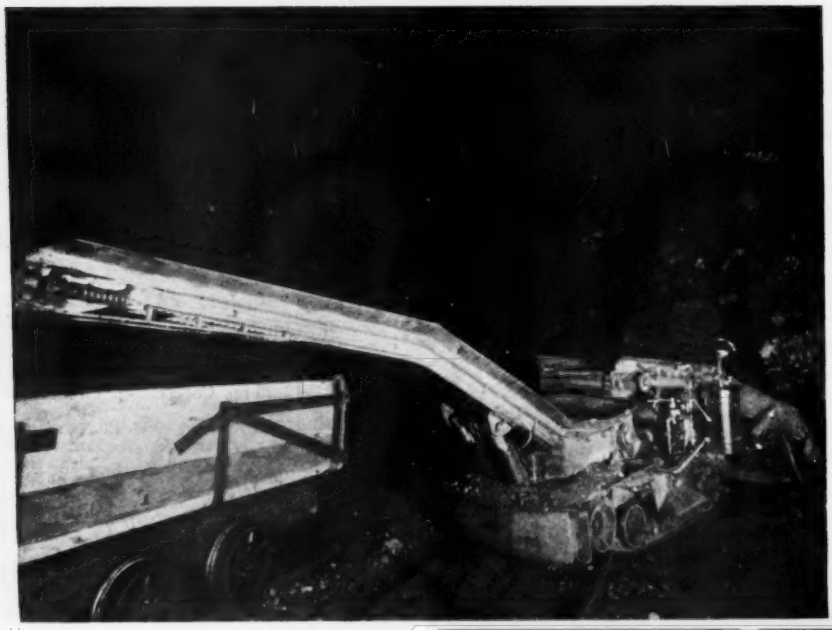
6 5-hp. Eickhoffs operating as auxiliaries to other conveyors.
11 Northern loaders in Rock Springs No. 8 Mine, 5 of which are operating alone, 6 are used with Eickhoffs when required.
1 Northern loader on ground at Rock Springs but not installed.
3 Northern loaders operating with Eickhoffs at Reliance.
5 4-BU Joy loaders at Winton not operating.
Butler shovels at Hanna operating in rock work.
8 scrapers.
55 shaking conveyors (large and small).

History and Development of MECHANIZA TI

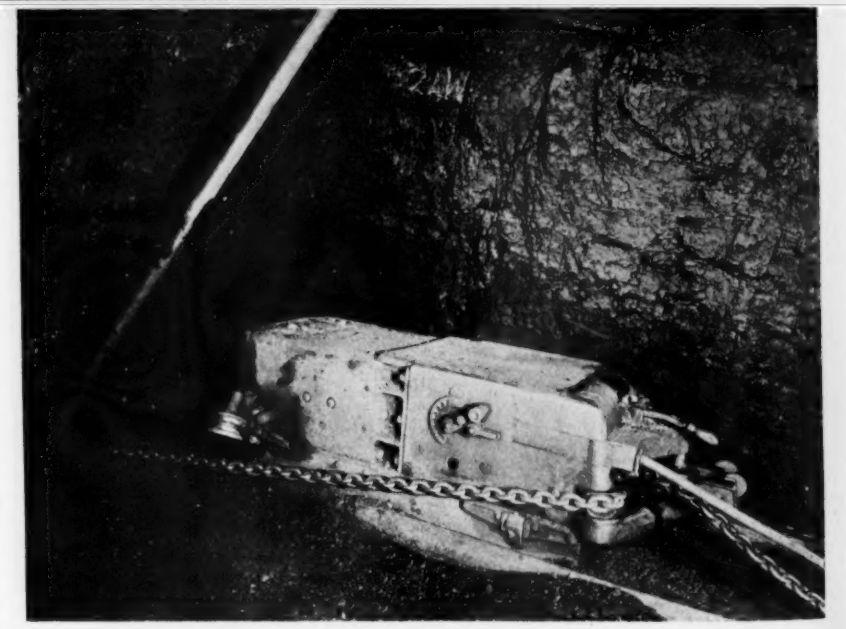
Geology of field—description of mine and seam—early experiments with cutting and loading—present status including shop practice, handling material, and training men for mechanical supervision

THE HANNA coal measures lie entirely in the Tertiary Geological period, the measures containing coal being designated as the Hanna series. This series is composed of alternate layers of sandstone and shales all of which are very weak and not self supporting. The entire field is very badly faulted and in many cases has been subjected to severe folding and horizontal strains. This condition makes the economic mining of these measures very difficult on account of the large amount of rock tunneling required; also the rapid changes of pitch in parts of the basin complicates haulage and mine layout. The coal is lignitic in structure and of comparative weak compressive strength; this coupled with very rapid increase of cover makes the mining of lower measures very troublesome due to bumps and spontaneous combustion. While the middle portion of each seam is comparatively free from sulphur the upper bench in all cases contains free sulphur which causes spontaneous combustion wherever this top measure is broken.

Figure 1 shows a general cross section through the measures now being worked. The No. 1 seam has been almost entirely worked out in the Hanna Basin and the present workings are now all in the No. 2 seam. This has a thickness of 32 ft. No. 2 mine has been working in this seam since 1889 and is almost worked out. No mechanical loading was ever attempted in this mine. No. 4 mine was opened in 1911 and was laid out for hand operations as no mechanical loading was contemplated at that time. Many millions of tons remain to be mined from this seam, however, and the plans at present are to mine this entire reserve by means of mechanical loaders of various types.



Showing chunks in top coal pile. 5 BU. Joy Loader



Sullivan cutting machine in pitching place

Mine Layout and Description

Figure 2 shows the mine map of No. 4 mine as of December 31, 1928. From April, 1911 to December 31, 1928, there were 4,462,169 tons mined and it will be noted that the present area covered by these workings is very small as compared with this tonnage. This gives one some faint idea of the enormous thickness of the deposit.

No. 4 mine was laid out in accordance with what was at that time considered good mining practice, and, for a standard hand operation of that day was quite satisfactory. Large barriers could not be left with any economy in the hand mining operations as yardage charges were always excessive in this field and

* Superintendent, Hanna Mines, The Union Pacific Coal Company.

TION at HANNA MINES

By O. G. SHARRER *

progress was so slow that where large barriers were left the investment in entry development soon became excessive. Rapidity and cheapness of development now makes it possible to leave almost any reasonable size of barriers and these barriers due to the possibility of concentrating loading machines makes for a very economical operation when the retreat of a mine is started.

Haulage entries were originally laid out to care for comparatively slow haulage from hand loading and have not been suitable for the concentrated haulage necessary from mechanical loading. The plan of mechanical mining has been adopted to these conditions in so far as possible and the information gained will permit the planning of any new operations in such manner as to eliminate practically all of these difficulties.

No. 4 mine workings are cut by three major faults which necessitate the driving of an average of 700 ft. of double tunnel or approximately 1,800 ft. of single rock tunnel to get through them on each entry. This rock work has been very expensive and naturally the plan has been to cut these faults in as few places as possible. In each case a panel has been projected to work out each section of coal between faults and in some cases this has caused the rooms to be very long, in some cases over 1,000 ft. In low coal this would be very uneconomical but in this particular seam this method has worked out as an advantage for machine loading. Our experience to date shows that rooms work best when planned for a depth of from 800 to 1,000 ft.

EARLY EXPERIMENTS WITH MACHINES OF VARIOUS KINDS

When this mine was opened in 1911 no attempt had ever been made to undercut this coal by any type of machine and all coal was shot from the solid. This practice was very undesirable from a safety standpoint and also made a very poor quality of coal, particularly from narrow places. No chain machine of that date was successful in cutting pitching coal so that the first attempt to mine this coal was by means of a Radialax post puncher. This machine cut in the top and made a very good job of cutting but was very slow and also was subject to all known kinds of mechanical and electrical failures; this coupled with the fact that the miners did not take kindly to any kind of mining machine made the successful operation of these punchers very difficult. After a long trial period and much grief the machines finally worked well enough to make a fairly good entry driving machine and were worked until they were worn out.

At about this time, 1912, the Sullivan Machinery Company had developed their CE7 machine to a point where they could recommend its use in pitching seams and two machines of this type were purchased. When one sees how easily the coal is undercut today they can have no idea of the difficulties encountered when these machines were introduced. Practically no data was then available as to bit shapes, chain lacing or speed and we had no idea of what type of feed would be necessary to cut this coal. We had no machine runners and runners imported from other fields knew nothing about cutting pitching coal.

We had not the faintest idea of what to expect from these machines and the rank and file of miners were, as usual, opposed to their installation. All in all the introduction of chain machines for undercutting presented a much more difficult problem than the introduction of loading machines at a later date. We learned to operate these machines by tearing them up and rebuilding them until everyone around the plant knew every piece of a Sullivan CE7 by sight and knew just where it went and why. Our own men finally learned how to cut our coal and from then on machine undercutting has given very little trouble; in fact, the cutting has become so simple a step in the entire operation that we are prone to forget that we ever did have any trouble from this source.

When the undercutting of the coal was finally successful the ground was then prepared for the introduction of a loading machine if such machine had at that time been available. However, at that time, 1914-1915, no loading machine was even contemplated for men were plentiful, labor was cheap and tonnages could be maintained easily without recourse to additional machinery.

Changing conditions in 1915 due, in some part, to the World War, caused a labor shortage that made urgent demand for some sort of mechanical aid to production. Much thought and study was given to the possibilities of various coal and rock handling devices but no machine which primarily designated for such service was then available. After a very extended study of the entire subject it was found that the small Thew shovel was apparently the only machine that had been developed to an extent that would justify its introduction.

Thew shovels were therefore purchased and put to work in 1916 in an experimental way. This shovel could work very easily, as heights of 26 ft. were easily obtainable and the problem of sufficient clearance did not enter into the operation.

No one ever seems to be lucky enough to hit the correct solution of a problem the first time it is attempted and the first attempt to load with the Thew was rather stupid when viewed in the light of our later experience. We could not vision taking a portion of the seam and leaving top coal for the Thew operation, so an attempt was made to take a full face of about 20 ft. and cut and prepare Thew coal the same as for hand loading. Cutting and blasting this face of coal proved to be impossible as the face was so high drilling could not be performed in any safe manner and the cutting machine was under a tremendous handicap as it was quite frequently covered up by the face turning over.

After a very short period of experiment with the full face the Thews were put loading top coal from places where the bottom 7 ft. had been taken out by hand miners. This worked out very well and the Thew operation has been changed very little since that time.

First successful loading with Thews started in the latter part of 1916 and the various difficulties of blasting, car service, and maintenance were gradually eliminated. The hardest problem to solve for Thew loading was the proper blasting of the top coal so that the coal would not come down in lumps which the Thew could not handle. This still

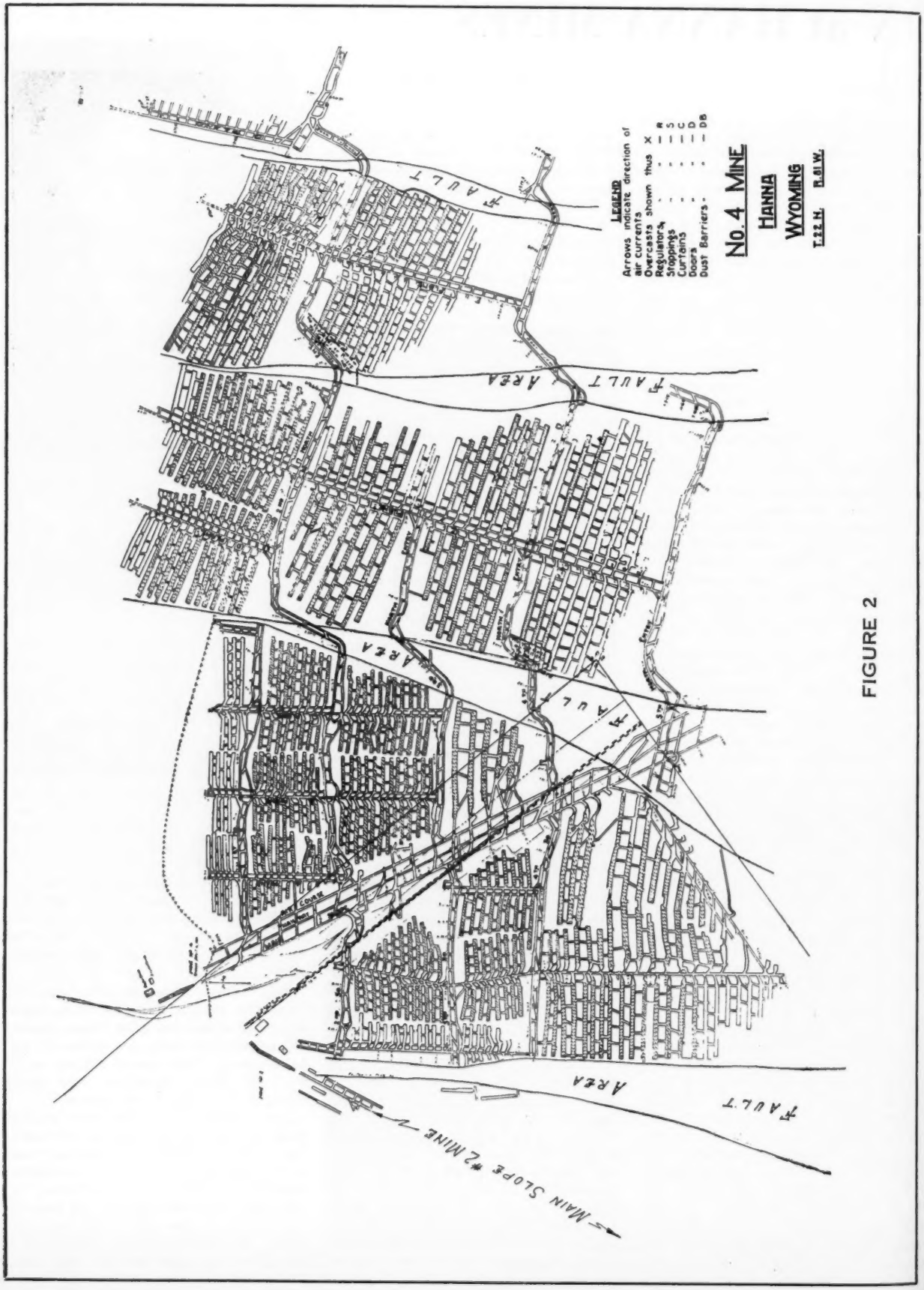

LEGEND
Arrows indicate direction of air currents
Overcasts shown thus X - - - R
Regulators - - - - S
Stoppings - - - - C
Curtains - - - - D
Doors - - - - DB
Dust Barriers - - - - DB
No. 4 MINE
HANNA
WYOMING
T. 22 N. R. 81 W.
FAULT
AREA
FAULT
AREA
FAULT
AREA
FAULT
MAIN SLOPE #2 MINE

FIGURE 2

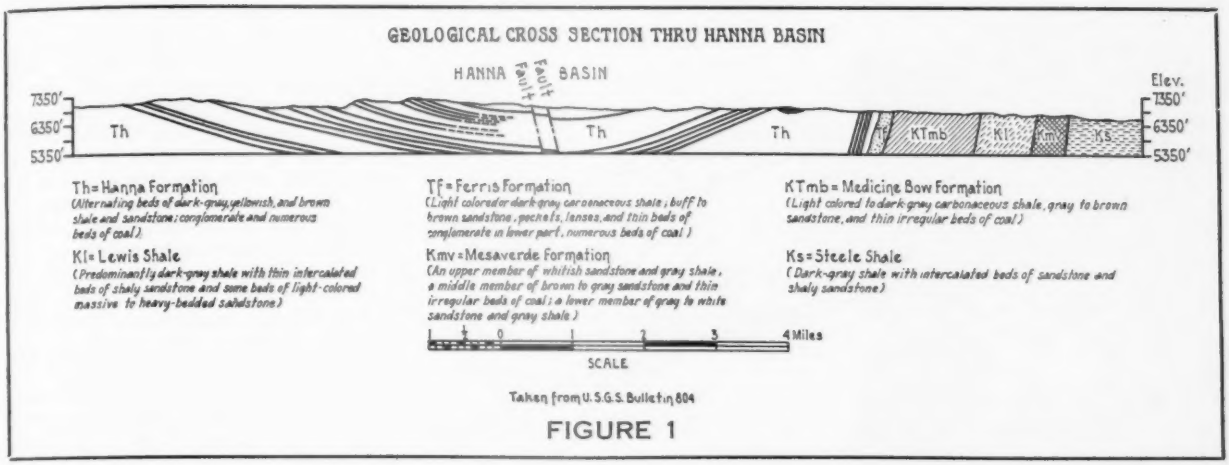


FIGURE 1

presents some difficulty but a careful study of placing of holes and different kinds of powder has cut this source of delay to a negligible factor. When the Thews got underway it was soon found that rooms could not be advanced rapidly enough by hand methods to keep the Thews in continuous operation and a search was started for a machine that would advance the rooms in the bottom bench rapidly enough to keep the Thew shovel in continuous operation. The Joy 5-BU has proved to be the answer to the room driving question and since their installation the Thew shovels have had a continuous supply of coal.

No. 4 mine is now operating at practically 100 percent mechanical loading. The only hand loaded coal being track clean-up and some coal from room necks to allow the Joy to get in the clear of the panel. With the shaking conveyor all of this room neck coal is being loaded mechanically which leaves only the track cleanings to be loaded by hand.

This mine has proven that 100 percent mechanical loading is not only possible but that it is the most economical method by a very large margin. Every kind of place can now be loaded out by some type of machine and at much lower cost than by hand methods.

Shop Practice on Maintenance and Repair

The maintenance and repair of the large amount of machinery needed in a mechanical mine requires a much more elaborate shop equipment than is customary at a hand plant. Loading machines are quite complicated and require high calibre mechanics to repair them. Hanna shops are equipped to handle almost any kind of machine work and in addition have a complete welding shop. Both electric arc and acetylene are used and the tendency is to use electric or acetylene welding to replace all riveting and press fits. Worn parts are built up with the electric arc or remachined to proper fits with a great saving of cost.

The machine shop is in charge of a master mechanic who also has charge of methods and practices in underground repair. The electric shop is in charge of a chief electrician who also directs underground electric repair. All armature winding and motor repair is done in the local shop which requires that it be well equipped to care for the variety of work that must be handled. Electric power is generated locally and the master mechanic has charge of the boiler room and all steam using machinery. The chief electrician has charge of the turbine room and all electric equipment. The master mechanic and chief electrician keep in close touch with the inside mechanical loader foreman so that they are always informed concerning needed repairs.

In almost all cases complete assemblies for the various units are kept in readiness at the main shops and when they are needed underground, the inside loader foreman gets into immediate communication with the main shop and the part needed is sent by truck and gets into the mine with a minimum of delay.

Handling of Material

The carrying of exceptionally high priced repair parts for mechanical loaders runs the material balance up beyond the amount necessary in hand mining. If the material balance is not to get out of line a very careful check must be kept of this department. When a machine is starting out, naturally, one can not tell what repair parts are necessary and the tendency is to carry an excess of repairs. However as the machine works into form it is found that a certain number of parts are subject to failure; these parts must, of course, be carried in stock but only one of each is necessary as replacements can now be obtained in a comparatively short time.

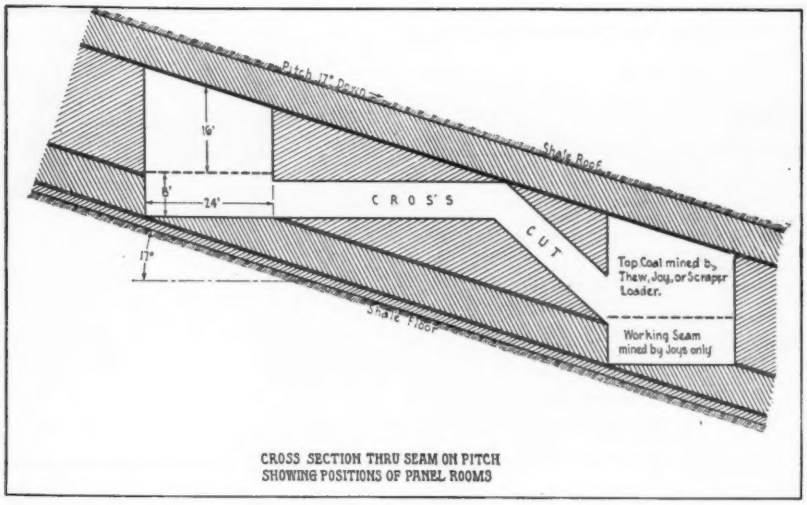
The practice at Hanna mines at the present time is to carry a replacement for each part that breaks frequently, only one part being carried in each case. When this part goes out to the mine the material clerk places another on requisition, this affords protection from delay at all times and does not require a heavy investment in idle material. With proper shop equipment many parts can be reconditioned and made as good as new. The greatest saving in this respect can be made through proper use of electric and acetylene welding.

Material charges are a considerable item in the unit cost of machine units and requires very close attention. The present method of cost accounting shows the materia' charges for each unit and for each shift. This permits a check on material used every day and prevents the cost from getting seriously out of line.

Training Men for Supervision of Mechanical Loading

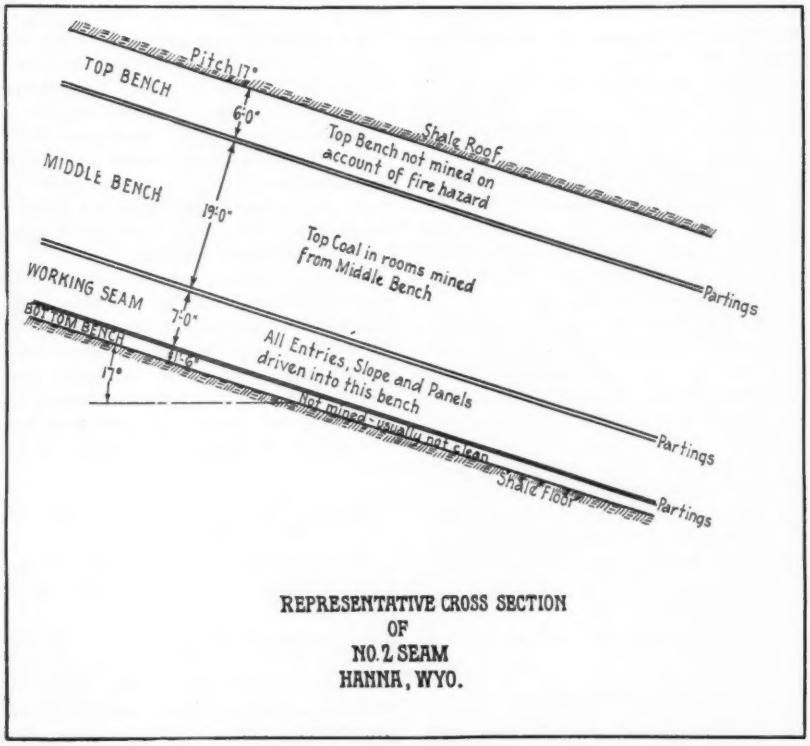
A mechanized mine requires an entirely different kind of supervision than a similar mine operated by hand. In hand operations the supervision consists almost entirely of what one might call personal relations, that is, the contact is with the individual miner, and the official that has the gift of "getting along with men" is almost invariably successful. In a mechanized mine the problem is much more complicated, for while the personal problem is more difficult, in addition, there is the problem of supervising the operation of many machine units.

The old-time underground official prided himself on his knowledge of human nature and his ability to handle bad roof, gas, etc., but left the handling of any mechanical problems to some other party. He was not particularly interested in machinery and did not consider a knowledge of its operation as being essential to holding down his job. A knowledge of ventilation, gases, etc., is still essential in a modern mine but



CROSS SECTION THRU SEAM ON PITCH
SHOWING POSITIONS OF PANEL ROOMS

FIGURE 3



REPRESENTATIVE CROSS SECTION
OF
NO. 2 SEAM
HANNA, WYO.

FIGURE 4

this knowledge alone is not enough. In addition to the old line mining technique the modern mine official must have a general knowledge of the various machines in his charge. He must be "machine minded" to the extent that he sees his mine in complete relation to the machine and not as a separate unit.

In the first inception of machine loading this situation was understood and the immediate solution of the problem was to allow the old line mine foreman to have charge of the ventilation, safety, personal relation, etc., and the machines were put in charge of another man who had charge of their operation. This was the only solution possible at that time and is true to some extent even now for there are not enough machine-minded foremen to take charge of all mechanical mines.

Any system, however, that leads to a division of authority and responsibility is not proper and can not long survive. A coal mine during the operating shift resembles a ship at sea, the mine foreman taking the rank of captain, and when a ship leaves port the captain has absolute authority over every one on board, even the owner of the vessel having no authority to issue orders. The authority of the mine foreman should be as absolute as that of the ship captain but in order to exercise this authority the foreman must represent the very best of his profession. In order to be able to exercise this absolute authority over all men in his charge the foreman must have a general knowledge of all the various phases of the operation to such extent that he can intelligently direct all of his subordinates. This does not mean that he must be an expert electrician, for instance, but that he should have the general knowledge of electricity that can be acquired by any layman who is interested enough to give the matter some study.

In many cases the older foremen were lukewarm or even actually opposed to machine loading and naturally the new methods could not succeed until they were replaced by men having a different attitude of mind. This led in many cases to the promotion of young men from the ranks of motormen and chain machine runners, these men never having given much thought to the position of foreman. Some of these men have been very successful while others have failed but the experiment as a whole has proven that men who come up through the positions of machine runner, loading machine operator, machine boss, etc., make the best foremen for a mechanical operation. In the past men of this kind were not obtainable but as mechanization grows older there is an ever increasing number of young men who have grown up with machines who are available for official positions. Some success has been attained by taking graduates from the mining schools and training them directly as mine officials, however, in this connection there is no more reason to expect a mining engineer to become a successful official merely because he has a diploma than to expect a good machine runner to be a success. The factors of personality, honesty, and dependability which are so essential in an official are not the product of a college but are traits inherent to the man himself and are just as liable to be the property of a good timberman as of a college graduate.

There are never enough good officials to fill all jobs so it is one of the duties of management to be ever on the alert for possible talent. A man suspected of having ability along this line should be observed very closely and when an opportunity arises should be given a chance in minor capacity. He should not be petted or pampered in any way, in fact, his treatment should be fairly severe in order to find out if he is the type that can stand punishment. When a man gets a (*Continued on page* 127)

MECHANICAL Operation at Hanna Mines

By J. V. McCLELLAND *

Descriptions of operations with large electric shovel, mechanical loaders, rock shovels, scrapers and conveyors—Mechanical loading on 100 percent basis—Slope driving in heavy pitch and thick coal—Description of drainage and ventilation

THE Union Pacific Coal Company's Hanna mines are located adjacent to the town of Hanna, Wyo., which is on the main line of the Union Pacific Railroad about 135 miles west of Cheyenne.

Mechanical loading in the Hanna No. 4 mine dates from January, 1916, at which time the first Thew shovel was put into operation. Another unit of similar type was installed in July, 1917, and during 1918 two more shovels of the same make were introduced. Two of these loaders are still in operation. The Thew shovel is an electric driven machine of the swinging boom type similar to those used in strip pit mining or railroad grading work. Since these shovels require a minimum of 15 ft. overhead clearance their use in underground mining is prohibitive in ordinary mining operations. Only the very unusual conditions of roof and height of coal prevailing in the Hanna mines, when the seam is 32 ft. thick, makes their use possible.

Results obtained with Thew loaders showed that mechanical loading could be carried on successfully in the Hanna mines providing the proper type of equipment could be obtained. To carry out this policy of mechanizing the mines two Joy loading machines of the 4-BU type were installed during 1923. Results obtained with these machines led to the installing of more of the same type during the years 1924 and 1925 until 12 of these loaders were in operation. These machines were only partly satisfactory as they were not built heavy enough to withstand the hard usage to which they were subjected. The 5-BU type of Joy loader was introduced in 1928, and were so far superior to the smaller type that the number of machines was increased until at present there are seven of these in operation. The 5-BU type is of heavier construction, and is better adapted to Hanna conditions.

In line with the Union Pacific Coal Company's policy of mechanization it became necessary to install some type of loading machine suitable for entry driving. To this end an Eickhoff shaking conveyor was installed in 1927. This conveyor was equipped with a "Duck-Bill" at the front end to eliminate shoveling on the pans. This "Duck-Bill" was designed by the Rock Springs Loader Co., and has proven very satisfactory. About 90 percent of the coal is loaded without shoveling by using the "Duck-Bill" and swivel pan arrangement. At present there are two of these units in operation and are used for driving panel planes to the raise on a pitch of from 12° to 15°. Experience shows that the shaking conveyor is capable of advancing these planes about 400 ft. with one setting of the drive. As these conveyors advance up the pitch some means of handling the coal from the end of the conveyor must be provided. In order to avoid installing hoists to supply cars to the conveyor a very practical auxiliary conveyor has been built by the resident master mechanic. This is a "button conveyor" with a series of "buttons" each two inches in diameter and two inches long fastened on a ⅝-in. steel hoisting rope. This runs in a 16 gage galvanized iron trough. The drive for this conveyor is a small hoist with a grooved sprocket riveted on the drum driven by a 20-hp. motor. The shaking conveyor discharges into a bin through which the button rope passes, thus conveying the coal to the loading station on the entry at the foot of the panel. The present "button conveyor" is about 1,400 ft. long, and has proven a very efficient installation.

In order to determine the loading machine best adapted to Hanna conditions a type of scraper loader was introduced in 1926. The motive power for the scraper is derived from a double drum hoist manufactured to Union Pacific Coal Company specifications by the Vulcan Iron Works, of Denver, Colo. Two types of scrapers are used, one of the open end box type of company manufacture, and another of the Sauerman "Crescent" type. The use of scrapers is limited at Hanna to the loading of what is known locally as "top-coal." This top seam is about 19 ft. in thickness and is removed by second mining. The operation of scrapers is not continuous at the present time, but are used only when maximum production is required.

Another type of loading machine, known as the Butler shovel, is also used in Hanna No. 4 mine. This is an air-driven machine and was adapted from the metal mines for rock work. The presence of a series of faults in the Hanna seam necessitates the driving of rock tunnels at fairly regular intervals, hence the need for a machine of this type. Air is supplied by Sullivan compressors, Type WK, size 10 in. by 10 in., installed at locations convenient to the operations of the shovel. The machines are well adapted to the work, have low maintenance cost and are an economy on account of labor saving. No attempt has been made to load coal with this machine, as the supplying of air is not convenient for any extensive operations.

Mechanical loading is now on practically a 100 percent basis. The only coal loaded by hand coming from room necks being opened up for Joy loaders. At the present time the No. 4 mine is producing 1,700 tons of coal per eight-hour shift, the average production per unit being: Thew shovels, 200 tons; Joy loaders, 215 tons; and shaking conveyors, 55 tons. In the use of shaking conveyors for development work it is of more importance to obtain yardage than high tonnage. The scraper loaders when

* General Inside Foreman, The Union Pacific Coal Company.

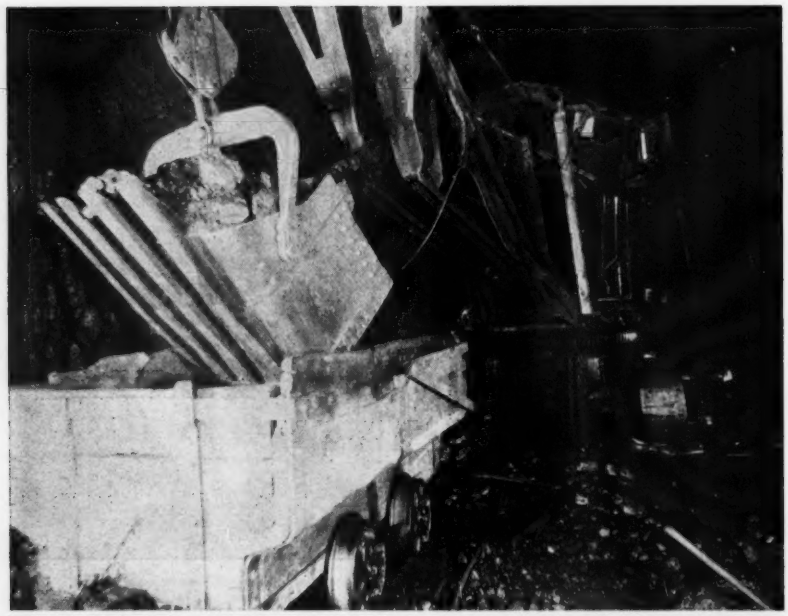


Figure 1 *(left).*
Thew shovel

operating will load on an average 270 tons of coal per shift.

The coal at Hanna is a good grade of lignite rated at 11,500 B. t. u. The average section of the seam is as follows:

Coal, 6 ft.
Thin parting.
Coal, 19 ft.
3-in. bone or rock parting.
Coal, 7 ft.
Coal and bone, 1 ft. 6 in.
Clay bottom.

The partings between the coal vary in different parts of the mine, and become thicker going to the dip, particularly the 3-in. band between the 7 and 19-ft. benches. The coal dips to the southeast, the average pitch being 17 degrees. A series of dip faults are encountered as the entries are advanced. Overlying the coal seam is a band of shale of variable thickness, but averaging about 8 in. Above this shale is a sand rock of considerable thickness.

The mine is opened by means of a slope which crosses the pitch at an angle of 25°. Parallel to this slope are driven the manway and return air course. Development work is by means of two parallel entries driven on motor grade along the line of strike. Panel entries are driven off these cross entries and their location is determined by the faults encountered as the headings advance. In some cases only one panel entry is driven in the section between two faults. Rooms are turned off these panels and may attain a depth of 1,000 ft. before reaching the fault. Panel planes are advanced to the raise by means of shaking conveyors. These panels are driven in the 7-ft., or bottom seam. Rooms turned off these panels are driven level to permit better operation of mechanical

Figure 2 *(left.)*
Joy No. 5 at face

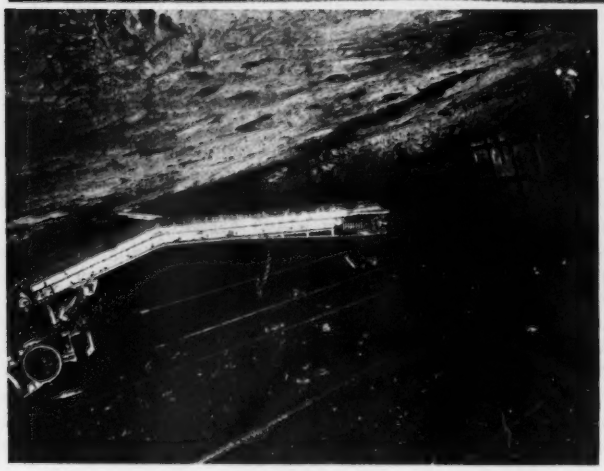


Figure 3. Joy No. 5 moving on panel

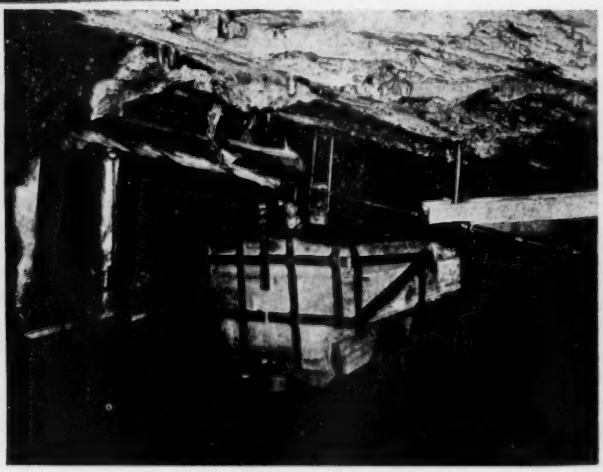
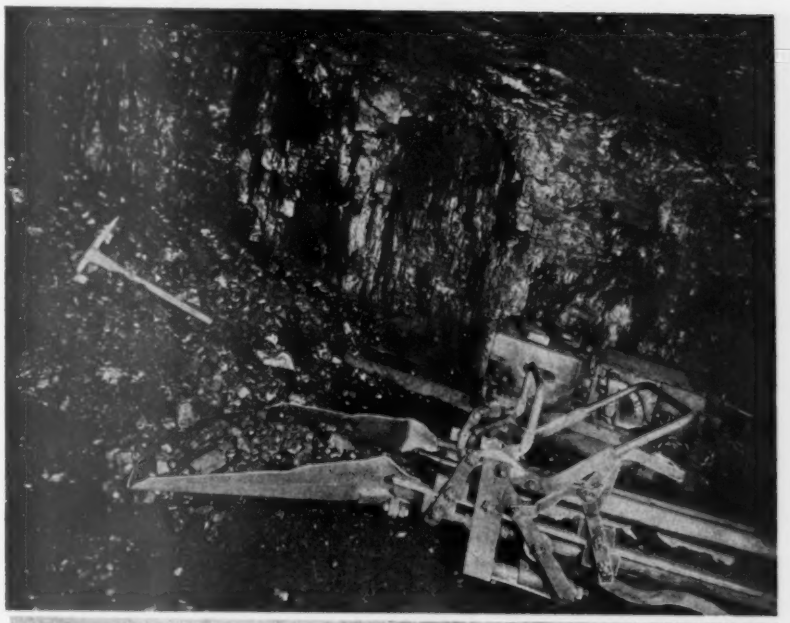


Figure 4. Button conveyor—loading end

Figure 7 (right). Eickhoff at face with "Duckbill," high coal type



loaders. When these rooms are widened to 24 ft., which is standard, the high rib is on the bottom of the 7-ft. seam, and the low rib is 3 or 4 ft. up in the 19-ft. seam. (See *Figure 3.*) All panel planes are driven in the bottom or 7-ft. seam. Cross entries are driven in the bottom of the top or 19-ft. seam. By this method the rope haulage on planes does not interfere with motor haulage on the cross entries.

Mining in rooms is two distinct operations. The room is advanced to the fault in the bottom coal by means of Joy loaders, and the top bench is then removed by Thews, Joys, or scraper loaders. In the recovery of top coal by means of Thew shovels or Joys the coal is shot down ahead of the machine for a distance of about 75 ft. Care must be taken not to have more than this amount of broken coal on account of the pile firing before being loaded out. The advance of a loading machine in these piles averages approximately 10 ft. per day. After the top coal has been recovered the Thew shovels are moved back under their own power to a cross-cut near the neck of the room which has been so driven that it is on the regular pitch of the seam. When the shovel reaches this cross-cut it is snubbed down the pitch to the room below by means of an ordinary block and tackle.

After a Joy loader has cleaned up a room in the bottom coal it is moved to a position over the track by means of the caterpillar tractor upon which it operates while loading. It is then run up on wooden blocks to allow the wheels to be replaced for travel along the room track to the panel. After reaching the room neck the machine is moved to a new location by the panel hoist. Connection between loading machine and

Figure 8 (right). Centrifugal pump room

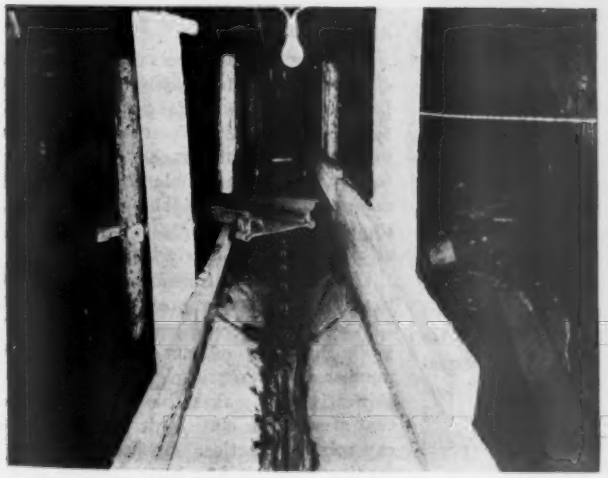


Figure 5. Button conveyor bin

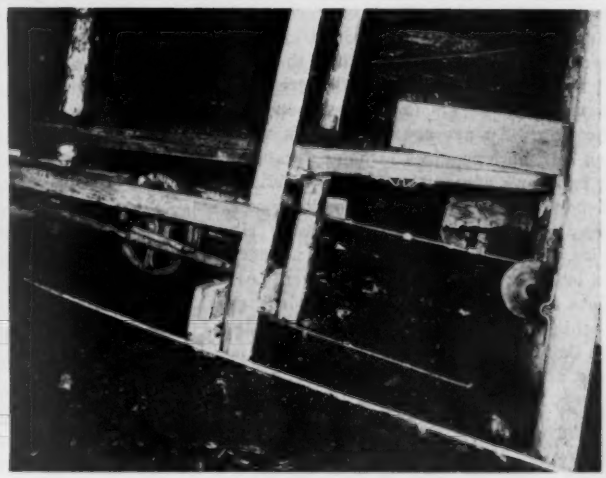


Figure 6. Button conveyor, tail sheave

Figure 9. Room showing face and little seam of rock between first and second cuts

panel trip is made (See *Figure 3*) with a short piece of hoisting cable. The length of time required for this move varies with the length of the rooms. An average of 30 minutes is required between rooms 500 ft. in length. This delay would be eliminated in flat seam work where machines could be moved between rooms by traveling through cross-cuts near the face.

In development work all coal is undercut with a Sullivan CE7 mining machine equipped with an 8-ft. 6-in. cutter bar. All mining machines have water on the cutter bars while in operation to eliminate the hazard of dust. Drilling is done with the Van Dorn one-man type drill and use a 1¼-in. bit. Where the coal is exceptionally hard it becomes necessary to mount the drill in a stand, but under ordinary conditions the holes are "breasted." Shooting is done with permissible powder by certified shot-firers. The shot-firers load, tamp and shoot all holes. On account of the "woody" nature of the coal and the lack of any distinct partings it is necessary to use a large amount of explosive in shooting. An average room 24 ft. wide and 8 ft. high requires 14 holes arranged in two rows across the face. Six sticks of powder are used in these holes and delay caps are used in the lower rib holes. The shots are fired in two rounds; the lower holes first, then the upper. All shots are fired with an electric blasting machine. Coal is cut and drilled on both the day and night shift, but shooting is done at night except when some delay in regular operation makes it necessary to shoot a place during the day shift in order to provide coal for a loading machine. The top coal is shot in three benches, and holes require a slightly heavier charge than in development coal.

Successful mechanical loading depends very largely upon haulage, particularly at the loading machine. Some system must be devised where-by cars are provided the unit without delay to insure continuous operation. A double track arrangement has proven quite satisfactory at Hanna, for by this method car changes can be made quickly and under ordinary conditions an empty car is always at the machine. Horses are used for haulage at the loading machines and to the partings on panel rooms. Haulage on panel planes is by means of electric hoists to partings on cross entries. Electric locomotives are used on cross entries to the main slope partings, and then by steam hoist to the tipple. Experience has proven that good track, properly maintained, and a sufficient supply of cars is absolutely necessary for successful mechanical loading.

Two shifts are employed at the present time. The day shift does most of the cutting and drilling as well as the ordinary maintenance work. Blasting and handling of material is the principal work of the night shift. Some coal is loaded at night in order to provide coal for hoisting at the beginning of the day's run. All panel planes and cross entries under development are double shifted in order to increase yardage. Regular crews are provided for each unit, and units are grouped under the supervision of a unit foreman. The Thew shovels are manned by an operator, one car trimmer, and two drivers. Joy crews consist of an operator, one face man, who is a relief operator, one car trimmer and two drivers.

The shaking conveyors are operated with one operator, one face man, one man at the loading head, and a machine crew of two men. While the shaking conveyor is operating in one heading the machine crew is cutting and drilling the parallel heading. Scraper loaders are operated with one hoist man, one operator, one loading head man, and a driver. In scraper operations the scraper discharges on to a flight conveyor which carries coal through a room cross-cut. The conveyor discharges into a gravity chute at the end of which the mine cars are loaded in the room below.

The drainage in the No. 4 mine is quite simple, as the mine does not make a large quantity of water. In general the drainage is down the pitch to the sump at the bottom of the main slope. From this sump water is pumped by a plunger pump to a sump of larger capacity which may be used as a storage reservoir in case of any derangement of the regular pumping routine. At this sump there is an Allis-Chalmers centrifugal pump capable of discharging 450 gallons per minute. This pump is set at a slightly lower elevation than the sump in order that water will flow into the pump. The water is pumped to the surface in two stages, the lower pump discharging into an intermediate sump about half way up the pitch to the outside. From this second sump the water is discharged at the surface by a pump that is a duplicate of the one at the lower station.

The main ventilating fan is a 20-ft. steam-driven Guibal. Auxiliary electric driven fans are installed on the surface at panels driven to the outcrop. The main slope and manway are the principal intakes, but some air is taken through worked out panels. Each cross-entry is on a primary split, and panels are on secondary splits off the cross entries. Panels are ventilated up the pitch, the air returning through the back entry at the top end of the panel. All underground stables, motor-generator set rooms, and pump rooms are on separate splits.

The tipple is of the cross-over type, capable of handling 2,000 tons per eight-hour shift. Shaking screens separate the coal into four different sizes of prepared coal. A coal crusher is an important part of the tipple equipment, on account of very large lumps produced in top coal mining. Slate is hand picked on conveyors leading to the crusher.

The unusual coal seam at Hanna presents an interesting problem in mining. The extremely high coal, fairly heavy pitch, presence of some gas, and the number of different types of loading machines in use, makes this operation one that stands in a class by itself in American mining practice. Opened as a hand loading mine, it has been changed to a mechanical operation very satisfactorily.

MINE OPERATION at SUPERIOR

By GEO. A. BROWN *
and F. V. HICKS †

George A. Brown

Description of seam and roof conditions—operation of shaker conveyors with Duckbill and loader in room and pillar system—number of men employed—methods of timbering, haulage and ventilation—sketches of mining system and photography of underground operations

F. V. Hicks

THE Superior mines of the Union Pacific Coal Company are located at Superior, Wyo., which is 25 miles from Rock Springs, Wyo., on the northeastern rim of Baxter Basin. Superior has a population of approximately 2,000, which for the most part are dependent either directly or indirectly upon the coal industry. Two independent companies, besides the Union Pacific Coal Company, are operating mines in this district.

The mines of the Superior district are in the Nos. 3, 1, 7, and Van Dyke seams. The various other seams which are more or less persistent throughout the Rock Springs field have their occurrence here as thin seams or else are excessively dirty.

The Union Pacific mines of Superior were opened in 1906. This group consists of five mines, viz, A, B, C, D, E, three of which are being operated at the present time, work having been temporarily suspended in two of the mines (A and D), in an attempt to concentrate activities, following the introduction of mechanical loading.

* Superintendent, The Union Pacific Coal Company.
† Assistant Superintendent, The Union Pacific Coal Company.

Physical conditions in the Superior district differ materially from those of other districts in the field. The coal has a higher thermal value than the others and is a most excellent steam coal. Due, however, to its friableness, the percentage of lump coal is much lower than that from other districts.

The No. 1 seam, which is most persistent throughout the field and workable in all districts of the field, is here worked by Lower A and C, and D mines. The measures pitch to the northeast, at an angle of 4 degrees (approximately 7 percent), necessitating slope haulage on all main haulageways on the pitch. This relatively gentle pitch of the measures in the Superior district constitutes its only physical advantage in mining operations over the various other districts, as tracks and track layouts are more easily installed and maintained.

Immediately overlying the No. 1 seam is a laminated shale of approximately 20 ft. in thickness. It is the belief of those most familiar with the Superior district that in the raising of the Baxter Basin anticline in some manner the measures at Superior, with their overlying strata, have been and still are subjected to lateral pressure. This lateral pressure tends to weaken the adhesion between the various strata of shale which constitute the major portion of the cover of the various seams.

This geologic condition, which is only encountered in the Superior district, results in a mining condition which is difficult, costly, and hazardous; however, it will be of interest to note that "C" mine, since its opening in 1906, with its particularly bad roof, has suffered fewer fatalities than some of our other mining properties where better roof conditions prevail.

The roof in working places, driven on the pitch in "C" mine, regardless of width, breaks immediately, and unless carried on timbers will cave to an arch. *Figures 1 and 2* will give some idea of this condition. Strike entries are seldom so affected where 18 to 20 in. of top coal is left up. In room work, after the place has been driven up its distance and the roof has taken its initial break, the roof condition in the pillar is always found to be very much better than in the rooms. While it is necessary to carry the entire width of roof in rooms on cross bars using 5 or 6 legs to the cross bar, only props are used in the pillar recovery. The breaking of roof

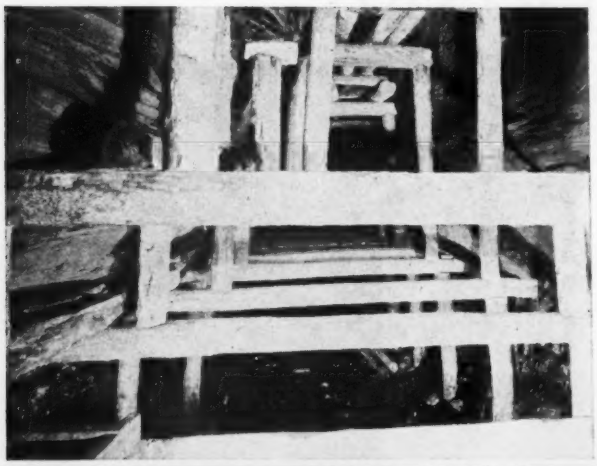


Figure 1 (left). Showing roof cave in a panel slope. Height of coal 7 ft. 6 in. Roof caved to an arch. Width of place 12 ft. "C" Mine, Superior

Figure 2 (left, below). Roof cave in entry. Height of coal 7 ft. 6 in. Width of place 12 ft.

Figure 3 (below). Picking refuse from pan line within the mine. Note gob on left side of pan

in this district. This is removed from the coal within the mine by boys placed along the conveyor pan lines. (See *Figure 3.*)

The Van Dyke seam in places carries a rock band within the seam. This is often 2 ft. in thickness. Above this band there is 5 ft. of clean coal with a good roof, and the mining in sections where this band occurs is carried on above the rock band, taking the 5 ft. of coal only.

Mechanical loading under roof conditions herein described, with most types of loading equipment, is quite generally considered impractical, and truly it would be with the heavy mobile types of loaders on the market today.

in places worked in advance relieves the lateral stresses in the roof, and none of the tendency to break that is encountered in the rooms and entries is found in the pillars when they are being recovered.

The roof in the lower levels of "E" mine acts quite similar to that in "C" mine, breaking in the narrow places either strike or pitch. However, the roof here does not break immediately upon being exposed. It at first gives every indication of being excellent, then, without warning, it may fall. This condition necessitates the placing of crossbars at all times, never allowing the working face to remain untimbered more than 5 ft.; enough to permit a cutting machine to cut the face. Such a roof condition is extremely treacherous, as the tendency always is to neglect the timbering on what has every appearance of being an excellent roof.

The roof condition in "B" mine is quite different from either "C" or "E" mine. Here the stratum immediately overlying the coal is a lenticular shale, which is full of slips and very irregular. Where water is encountered in the overburden, the roof requires extraordinary attention in the placement of timber.

Most of the coal so far mined averages from 7 ft. to 7 ft. 6 in. in thickness, and is for the most part free from impurities that occur within the seam itself. However, there is a clay band, varying from 2 to 8 in. in thickness, which is characteristic of the No. 1 seam

One of the two first Eickhoff shaking conveyor units shipped to the United States was consigned to the Union Pacific Coal Company at Superior. It was the thought of the management to first at-

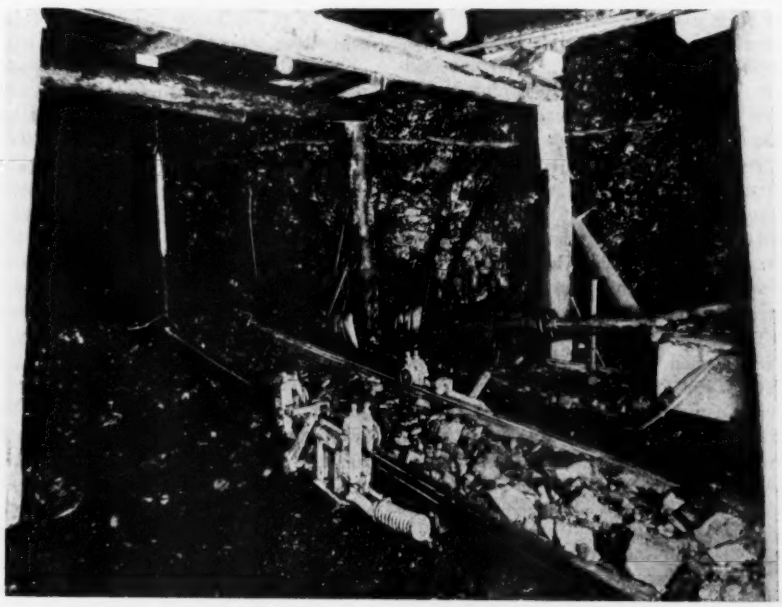


Figure 6. Low coal Duckbill attached to shaking conveyor. Note use of saddle-jack in supporting lagging before placing of permanent cross-bar

tempt mechanization of its loading operations under what was considered their most difficult condition. If successful here, it was thought it could be made applicable to other mines of the company.

With this introduction of shaking conveyors one fatal—but very common—mistake was made; that was the attempt to operate new machinery, whose operation and adaptability was not understood at the time, in a method of mining which was also new to the district, viz, long-face mining hand shoveling onto the conveyor. Little need be said about this operation, other than that the system failed. Inability to maintain an open working face over any period of time, prohibitive timber costs, and inexperience with the new machinery necessitated the abandonment of the plan, after several months of heart-breaking effort.

The conception, development, and perfection of the McCarty duckbill in the Rock Springs mines of the Union Pacific Coal Company, thus converting the shaking conveyor from a simple transporting machine to a loading and transporting device, proved to be the solution of conveyor operation in the Superior district, as it was found to be unprofitable here to use conveyors as a transporting medium only. Hand shoveling 100 percent of the coal onto conveyors showed no economy over ordinary hand-loading methods in these mines.

The loading equipment of this district consists of 7 Mavor & Coulson shaking conveyors equipped with 25-hp. motors, 6 Eickhoff conveyors with 25-hp. motors, 3 15-hp. Eickhoffs, 5 5-hp. Eickhoffs, 6 Northern conveyors, and 1 Jeffrey pit-car loader. All of the shaker conveyors are equipped with duckbills of the Universal type, which are manufactured by the Rock Springs Loader Company.

The room and pillar system of mining is used exclusively. With the heavy roof conditions that prevail all entries are driven to the boundary and worked on retreat. State laws necessitate that rooms be driven in pairs and crosscuts driven every 50 ft. This necessitates the use of a "swing crew," part loading out one place as the other is being prepared. These crews consist of from five to seven men at the face, depending upon conditions, made up of the following:

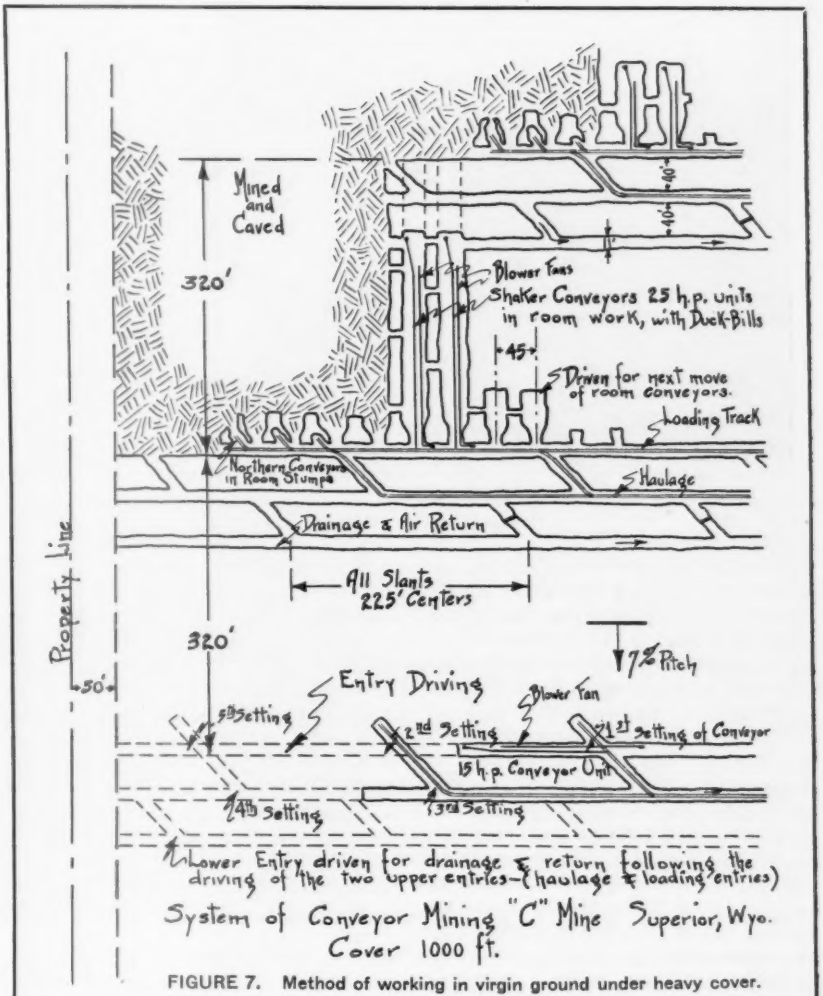


FIGURE 7. Method of working in virgin ground under heavy cover.

Figure 4. Method of timbering in rooms, timbers unbroken

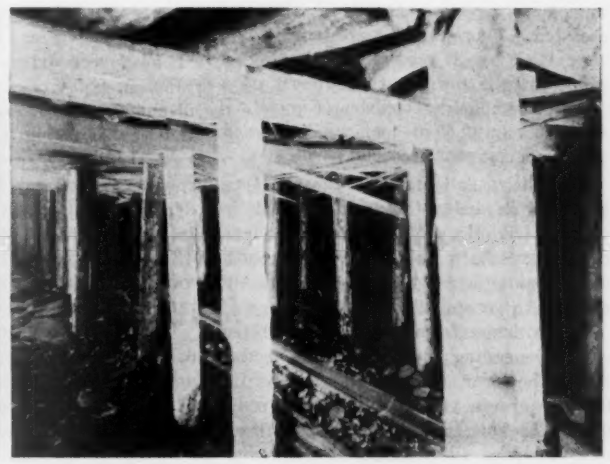


Figure 5. Room timbering, showing broken cross-bars

Figure 8. Loading head of conveyor used in driving entry work on strike of seam. Note slant used for car storage

One duckbill operator, two face men, two mining machine men who also drill the face, two timbermen when needed, and one loading head and haulage man. Such an arrangement permits of steady loading over a considerable period of the day. Much of the work of this nature is in "C" mine, where the cover is approximately 1,000 ft. The rapidity of advance of rooms and pillar recovery, under this heavy cover, alone makes economical mining of this seam possible. Costs under the old system of hand loading with its slow progress, necessity for many working places for an equivalent tonnage, track, retimbering, maintenance of clearance for cars, etc., would be prohibitive in this field. As it is, timbering costs—labor and material—often run for individual places as high as 25 cents per ton. Twenty ft. crossbars are used in rooms—room width 22 ft.—placed every 5 ft., with six legs under each crossbar, and lagging used over cross timbers. (See *Figures 4 and 5.*) The face is shot one hole at a time and lagging is immediately placed ahead of the last crossbar. These lagging are temporarily supported by a screw jack having a saddle at the top for the support of a cross or supporting timber. (*Figure 6.*) As soon as sufficient coal can be loaded out the permanent crossbar is set.

The entire fall of coal from the face is loaded out using the duckbill. This is made possible by shifting the center legs of the crossbars as necessity demands, using saddle screw jacks to temporarily support the crossbars when necessary.

The tonnage from these swing places varies, depending upon conditions encountered; however, the average manshift tonnage over a year's period is approximately 12 tons. Labor charged to these units includes all members of the swing crew—face men, timbermen, mining machine men, drillers, blasters—and one-half of the time for the loading head man, the other half being charged to mine haulage. Also all mechanical and electrical labor properly chargeable to the unit.

The swing crew is not the most economical. Single places, having a crew of three men at the face doing all loading, cutting, drilling, blasting, and timbering, produce the cheapest coal. State laws, however, prevent this.

Entries are driven on the strike, maintaining a slight grade favorable to the loads where the floor is regular enough to permit this being done. The three-entry system is used. The two upper entries are both on intake, the lower entry being used for drainage and return. The two upper entries are driven in ahead of the third entry, using one unit only in driving these two headings. State laws permit the driving of entries 300 ft. ahead of the last breakthrough in nongaseous mines, providing either line brattice or blower fans are used. Slants are driven every 225 ft. In moving the conveyor unit ahead after 300 ft. have been driven, it is located at the junction point of slant and entry. The discharge end of conveyor is so placed that the slant can be used for car storage, the empty cars being run in past the conveyor and loaded as they are dropped past, using the pitch to assist in moving the trip past loading end. (See sketch of entry driving showing various locations, and *Figure 8* of loading head on entry.)

The third or lower entry follows the driving of the upper two. One unit is used in driving this entry. The time of starting this third entry is so timed that it will reach the boundary at about the time of the upper two.

The 15-hp. Eickhoff conveyor equipped with duckbill is used in driving all development work on the strike. The slants are driven by the 5-hp. Eickhoffs. These are used discharging onto the 15-hp. unit, using the same crew but swinging them from entry to slant.

Entries average about 11 ft. in width, and 5 ft. 6 in. to 6 ft. in height, the top coal being left up. A double shift averages five cuts of about 40 ft. advance in 16 hours, machines being equipped with 8-ft. cutter bars.

Small 4-ton locomotives are used in serving conveyor units. Pit cars vary in capacity from 2,200 to 4,000 pounds at the various mines. Since all loading from conveyors is side loading, car capacity does not enter into the scheme of loading as it does with types of loaders and track arrangement necessitating end loading with individual car changes.

Since hand loading preceded mechanization in all the mines at Superior, the general mine layout is largely determined by this previous work. This, while well suited to the methods then in use, are not now well adapted. A large amount of work has been necessary to mine out straggling chain pillars, room pillars, and panels in order to obtain proper roof breaks to free the new work from riding weight. Most of the "easy coal" which is tributary to the Superior mines has been mined, and new work is being forced to deeper cover and more adverse mining conditions.

Little surface preparation is necessary in order to supply a clean, marketable product. All of the output is taken for railroad consumption, and since most of the coal is used for stoker firing, much of the coal is shipped direct to consumer as run of mine. However, provisions have been made for sizing the coal when market demands.

Of the three mines now operating, "B" mine is totally mechanized, about 60 percent of the loading equipment in this mine being double-shifted. "C" mine tonnage is produced both by hand loaders—all of whom are in pillar work—and mechanical loaders, which are double-shifted. The mechanical tonnage representing 65 percent of this mine's output.

"E" mine has as yet but little equipment. This consists of three Northern loaders used in room work and one 15-hp. Eickhoff, equipped with a duckbill, used in driving entry. This equipment, too, is double-shifted.

The total mechanical tonnage from the three operating mines represents approximately 60 percent of the total tonnage mined. As standing pillars are withdrawn, which can be best accomplished by hand-loading methods, additional loading equipment will be installed, ultimately completely mechanizing all loading operations.

MECHANIZATION at ROCK SPRINGS MINES

By T. H. BUTLER *

Mining plan described showing scrapers and Duckbill conveyors on long faces—Chain conveyor at end of face for loading mine cars—Detailed description of equipment and mining practices for all face operations — Entries advance with conveyors — Number of men employed on the loading and preparatory crews — Main line and gathering haulage described

THE desire for increased production and lower costs in the Rock Springs mines made it necessary to change the method of mining, from the room and pillar system of driving the rooms up the pitch, or the panel system of driving panel planes on the pitch with the rooms on the strike. Both of these methods required a large amount of machinery and a heavy gathering expense. In either of these methods of mining the empty cars had to be hauled to the working faces, and, where the rooms were driven up the pitch, hemp ropes were required to lower the loaded car to the haulage entry. This method necessitated the employment of many men and also created a hazard by the ropes breaking and allowing the car to run wild.

During the year 1923 the matter of installing mechanical means of transporting the coal from the working faces to the haulageways, other than by the old and dangerous method, was brought up, and after much thought and a great deal of experimenting, the shaking conveyor and the scraper loader were adopted as best suited to existing conditions. The use of these two types of coal loaders necessitated a change in mining methods from the room and pillar system, and the present system of working the seam in blocks was substituted with the installation of shaking conveyors and scraper loaders.

With this method slopes are driven on the pitch of the seam, and headings driven off the slopes, on the strike of the seam, at intervals of 600 ft. Conveyor ways are driven off the headings up the pitch at intervals of 100 ft. by use of shaking conveyors, equipped with the duckbill originated and patented by F. L. McCarty, mine superintendent of the Rock Springs mines, and his associates. The duckbill has proven efficient and economical, and is the outstanding feature in loading coal with a shaking conveyor. The conveyor ways are 10 ft. wide and 6 ft. high and are driven from the haulage entry to the breaking entry above, a distance of approximately 400 ft. During this advancement the entry is ventilated by the use of small blower fans and flexible tubing. Power for driving the conveyor pans is provided by 25-hp. d.c. motors.

The mining laws of the State of Wyoming permits shooting during the working shift, thereby making it possible under normal conditions to advance the conveyor ways a distance of three machine cuts, or approximately 22 ft. per eight-hour shift. Water is used on the cutter bars of all mining machines, permissible powder, and electric detonators are used in blasting, and electric cap lamps are used for illuminating purposes, all of which tends to lessen the hazards of blasting during the working shift.

The shaking conveyor brings the coal directly to the main haulageway and deposits it in the pit car which stands on the siding, or passing track off the main haulage track. After the conveyor ways are connected with the breaking entry above, the pillar is attacked by the long-face method, a kerf being cut along the entire face, the coal shot as needed, and it is then loaded by the conveyor equipped with the duckbill. In this manner the pillar is reduced until it is approximately 8 ft. in thickness, between the new and old places. The equipment is then moved to the new working place, and the same procedure followed until the coal in all the blocks has been extracted. The entry stumps are then recovered by the use of the shaking conveyor and duckbill, and conveyor pit-car loaders.

In mine No. 8 at Rock Springs, Wyo., where this system is used, the coal seam is approximately 8 ft. in thickness. It has marked cleats, but not very obvious bedding. The conveyor ways are driven directly up the pitch, which is inclined about 8 degrees from the horizontal. The roof on the whole is fairly good, though in places there are large crevices in both the coal and rock, which are filled with white sandrock dykes. Ordinarily props are set at intervals of 6 ft.

* Superintendent, Rock Springs, The Union Pacific Coal Company.

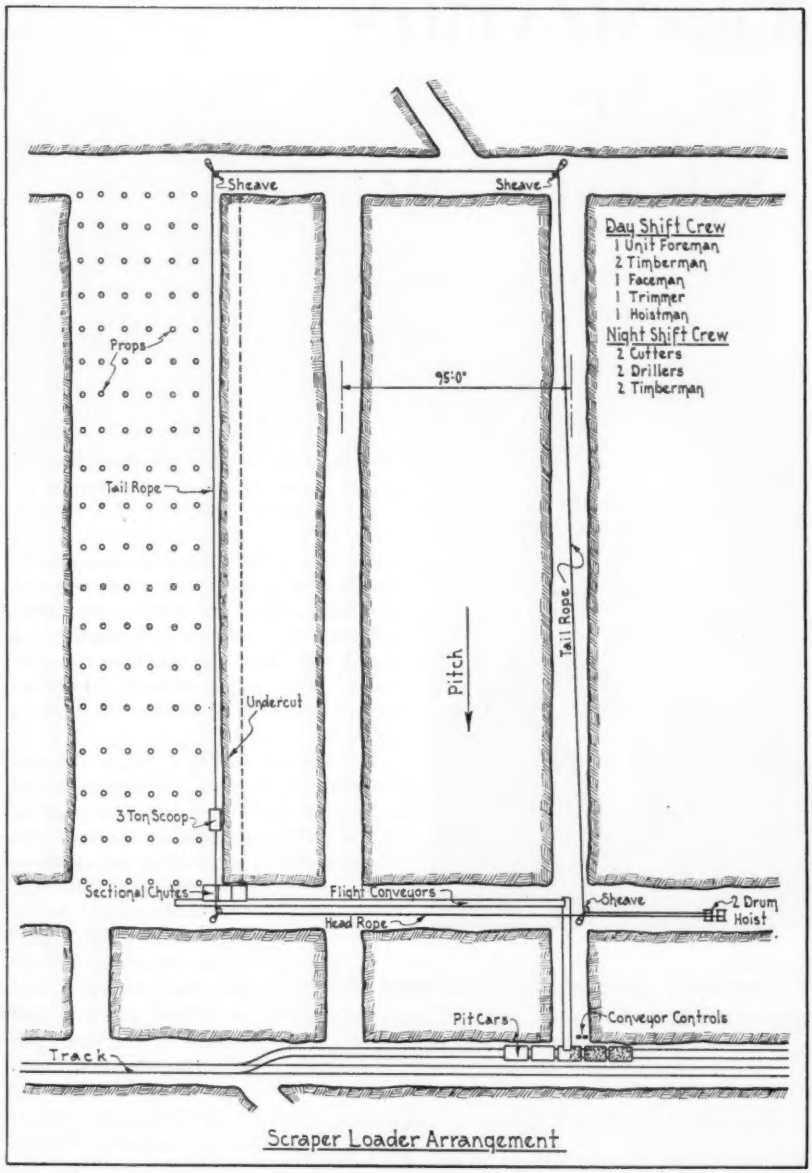


FIGURE 1

with substantial cap pieces, but where the crevices or breaks occur in the roof they are set at more frequent intervals, and in some instances cross bars are necessary. Special timbering is sometimes resorted to, a square stick of timber 8 in. x 8 in. x 8 ft. being placed with one end against the coal face, with a steel temporary prop supporting the other end. This usually keeps the roof from breaking until enough coal has been removed from the face to allow a prop to be placed under the other end without interfering with the operation of the conveyor.

In order to keep the coal from scattering when shot, to such an extent that the duckbill can not reach it, 2 in. x 12 in. x 16 ft. planks are placed on edge against the row of props nearest the face. There are 12 of these planks at each point where used, and as the face is shot down the boards are moved into position opposite the point of shooting. This means a saving of time and labor, as without the use of the planks the coal would be more or less scattered, and would have to be handled with hand shovels to a point where the duckbill could reach it.

As stated, the long face runs directly up the pitch, which is about 30 degrees off the butt. The coal would be won in larger lumps if the long face followed the butt cleat, but the size of the coal is not so important at the mines of the Union Pacific Coal Company as it is at the commercial coal operations.

When the long-face workings begin to show weight the timbermen proceed to draw the props, beginning at the upper end and working toward the lower, until all available props are removed and the roof caved. As much as 95 percent of the timber is recovered in this manner, which is remarkable in work of this kind, where the cover varies from 400 to 700 ft. in thickness. Timbers are cut the required length on the surface, and taken into the mine and delivered at the working faces as needed, thus eliminating delays to the loading units by men having to cut timber the proper lengths. Cap pieces and wedges are provided ready for use.

In the use of the shaking conveyors in the long-face work, extracting the blocks after conveyor way has been driven, the conveyor drive is placed in the lower breaking entry, and the conveyor pans are extended from the drive along the face. The coal is delivered by the conveyor pans to a flight or drag conveyor, which is installed along the breaking entry, which in turn delivers it to a short right-angle flight or drag conveyor, which delivers the coal to the pit car on the siding or passing track off the main haulage track.

In order to prevent the spillage of coal at the loading point, a sheet-iron plate is used, reaching from the rear end of the car under the loading head to the front end of the car following, so that when one car is loaded it can be moved out, and the empty car placed for loading without stopping the conveyor. The coal spilled on the sheet-iron plate is later dumped into the pit car, without blocking the track and interfering with the moving of the cars at the loading point. In order to load the pit cars to their full carrying capacity, the man at the loading head of the conveyor uses a potato fork, which is both cheap, light in weight, and convenient, and prevents injury to the hands of the man trimming the cars. Unless trimming of the cars is carefully watched, a great deal of coal is spilled along the haulage roads, and the men get into the habit of loading the cars light, which reduces the output materially, especially when the distance between the loading point and the tipple is great, as is the case in the Rock Springs mines.

To keep the conveyor pans in line, radius bars are used at points where the pans are swiveled or at any point desired. Jack posts are used as centers for the radius bars, which at one end are given a quarter turn, and formed in a ring to embrace the foot of the jack post. At a swivel one of the radius bars is put on the straight conveyor pan, and one on the opposite side of the swiveled length. Although the arcs which the

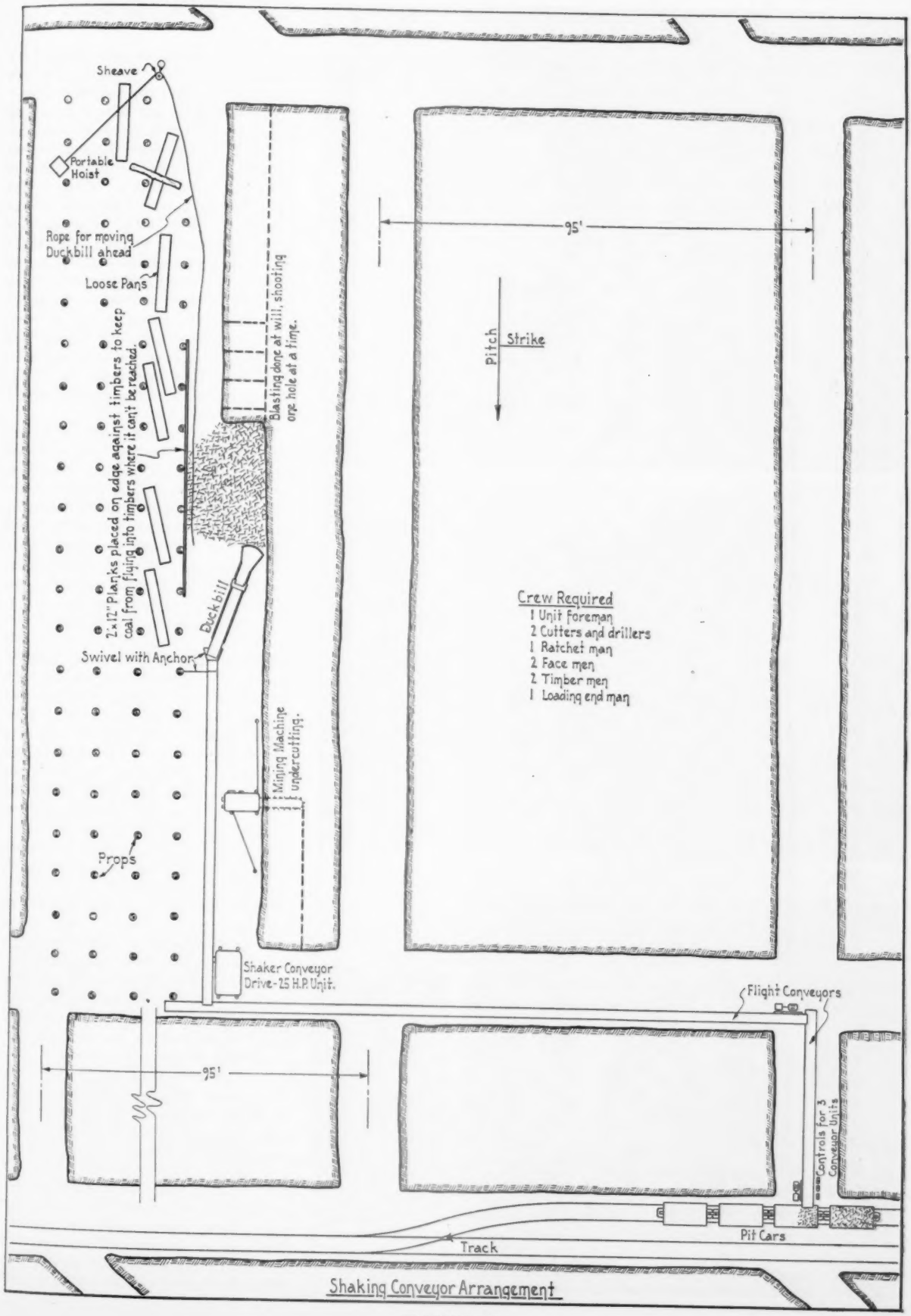
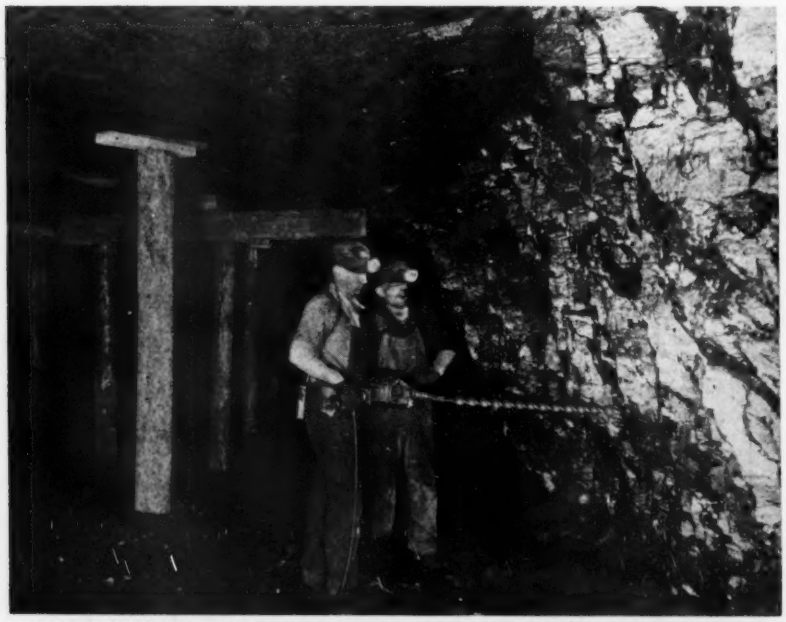
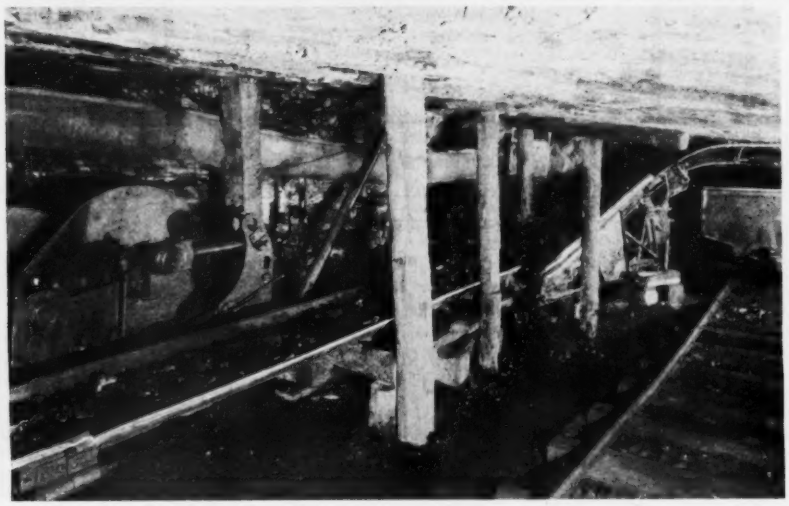

Sheave
Portable Hoist
Rope for moving Duckbill ahead
Loose Pans
2 x 12" Planks placed on edge against timbers to keep coal from flying into timbers where it can't be reached.
Duckbill
Swivel with Anchor
Props
Blasting done at will, shooting one hole at a time.
Mining Machine undercutting.
Shaker Conveyor Drive-25 H.P. Unit.
95'
Pitch
Strike
Crew Required
1 Unit foreman
2 Cutters and drillers
1 Ratchet man
2 Face men
2 Timber men
1 Loading end man
Flight Conveyors
Controls for 3 Conveyor Units
Pit Cars
Track
Shaking Conveyor Arrangement

FIGURE 2



Drilling long face ahead of Duckbill Loader, No. 8 Mine, Rock Springs, Wyoming.



Universal Duckbill Loader working on long face, No. 8 Mine, and, below, Shaking Conveyor discharging on separate unit for loading cars

bars travel are not parallel except at a single point, their divergence is not enough to occasion any real difficulty.

The drilling of the holes for blasting the coal is done with an electric machine supported by two men, the augur being fed by the pressure exerted by the men operating the machine. One of the prongs of the augur or drill bit is made with a square or chisel point and the other prong with a diamond point, which is arranged to lead the other prong ⅛ of an inch. This arrangement has been found to speed the cutting of the augur bit considerable, with a saving of power. The square point does the cutting, and the diamond point steers the augur. The holes are drilled to a depth of 6½ ft., leaving the back of the machine cut 12 in. in the clear.

From the year 1923 to date equipment has been added, and we have in operation at present 15 shaking conveyors, equipped with the duckbill, used in headings, conveyor ways, and the blocks by the long-face method. We are also operating one Goodman three-drum hoist unit on scraper loader, and three Vulcan double-drum hoist units, extracting the blocks on the long-face method.

In the advancement of headings with the shaking conveyors, one 25-hp. unit is used in each main and back heading. Each unit is operated by three men, who do the cutting, drilling, blasting, and loading, the unit producing on an average of 40 tons per eight-hour shift. In the driving of conveyor ways up the pitch by use of shaking conveyors, the cycle is the same as in the headings, the three men doing the cutting, drilling, blasting, and loading, and the setting of and timber necessary, the production from the unit being approximately 40 tons per eight-hour shift.

In the use of the scraper loaders on long-face work extracting the blocks after conveyor way has been driven, the hoist is placed in breaking entry a distance of approximately 150 ft. from the working place, a snubbing post to which is attached a sheave wheel being placed near loader landing station. The arrangement is shown in *Figure 1*. The main rope leads from one of the drums on the hoist, passing through the sheave wheel, and is then attached to the forward end of scraper. The tail rope, attached to the second drum, passes up the conveyor way and thence along the top breaking entry to a point in line with the working face, and down along the working face to rear end of scraper. Both the main and tail ropes are of steel construction and ⅞ in. in diameter. Along the lower breaking entry a flight

Vulcan Loader Scraper. Loading long wall face, No. 8 Mine

or drag conveyor is installed, which receives the coal from the scraper loader, which conveys it to a second flight or drag conveyor placed at right angles to the first, which deposits the coal in the cars on the haulage entry. The long face worked with the scraper loader is cut and drilled on the night shift, and is shot down during the working shift as the coal is needed. Owing to encountering bad roof in places, were the face shot down on the night shift it would have an opportunity to break during the lapse of time between the night shift and the day shift, while by shooting as needed timbering can be done immediately if necessary.

The type of equipment used in long-face work by use of scraper loaders consists of Goodman three-drum hoists, Vulcan double-drum hoists, box-shaped scrapers, Goodman undercutting machines, Van Dorn electric drilling machines, and Link-Belt drag conveyors. The number of men employed on scraper-loader units are as follows: One hoist operator, one bell ringer, one car trimmer, one unit foreman, two timbermen, the above working on the day or working shift. On the night shift six men are employed: One mining machine runner, one mining machine runner's helper, two drillers, and two timbermen, making in all a total of 12 men for the cycle. The average daily output per scraper loader is 300 tons.

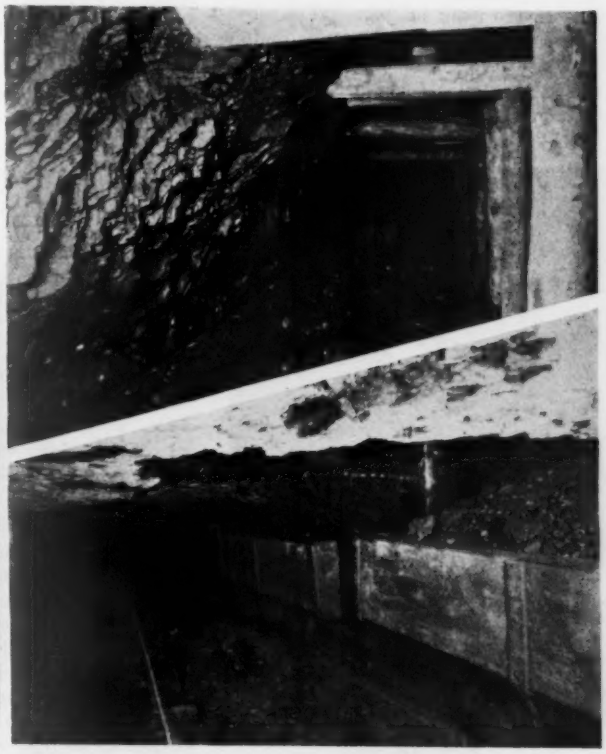
In the extraction of the blocks by the long-face method with shaking conveyors, the entire cycle is performed on the day or working shift, the mining machine cutting the lower half of the face while the conveyor is loading the upper half, and vice versa. The drilling, shooting, and timbering is all done on the working shift as needed. The number of men employed on long-face shaking conveyors being as follows: One machine runner, one machine runner's helper, one duckbill operator, one face man, two timbermen, making in all a total of six men. Average daily production from each unit, 175 tons.

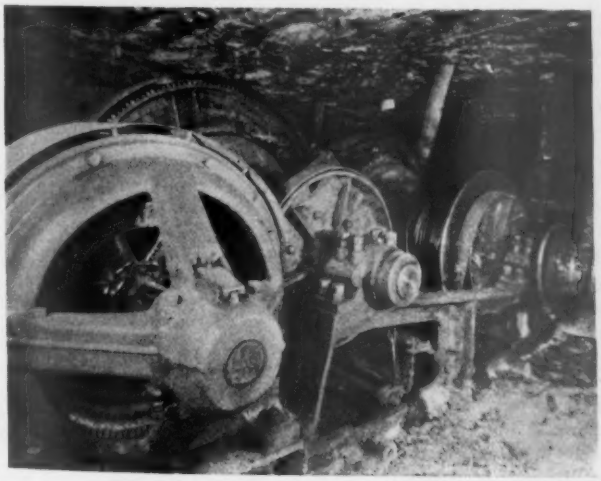
The track arrangements for the storage and changing of cars in serving the shaking conveyors and scraper loaders are similar. A passing track, sometimes called a siding or parting, is provided, being of such a length that it will hold a motor trip of empty cars inby of the loading point, and a motor trip of loaded cars outby of the loading point. The cars are fed to and lowered from the loading point by means of a hemp rope attached to the side of the trip of cars and passed around a horizontal post or roller placed at a convenient point, so that the loading head man can trim and drop the cars by (*Continued on page* 127)

Top, right—Mining machine and cut on long face, No. 8 Mine.

***Lower, right**—Loading end of Vulcan Scraper Loader, No. 8 Mine.*

Below—Two drum hoist used with scraper loaders.





MECHANIZATION at WINTON

Description of seams and physical conditions—Plan of mining system—Timbering, ventilation, cutting and haulage described —100 percent mechanized loading with loading machines and duckbill conveyor—Description of entry development with mechanical loader—Description of room work with Duckbill conveyor

THE WINTON MINES of the Union Pacific Coal Company are located 12 miles north of Rock Springs, Wyo., in coal seams which are extensions of the Rock Springs field.

There are 11 known workable seams in the Winton measures, all pitching from the horizontal at an angle of 14 degrees to the west. Five seams have been developed from the outcrop. The coal is of cretaceous origin and is quite hard. The roof and floor are composed of hard slate, overlaid and underlaid with heavy sandstones. Open areas will stand for a considerable length of time before caving.

The two seams which are being worked mechanically are generally known in this field as the No. 1 seam and the No. 3 seam. The No. 1 seam ranges from 7 to 12 ft. in thickness, with a bone or rock parting varying from a streak to several feet in thickness. The No. 3 seam lies 175 ft. above No. 1, is 7½ ft. thick, and is free from partings.

Rolls frequently occur in the strata, varying the pitch of the seams as much as 5 degrees. Cover in the mines, as at present developed, ranges from 50 to 400 ft.

Slopes are driven on the pitch, and usually consist of four headings, two intakes and two returns. One intake is used as the main haulage, the other as the manway. Seventy-five ft. is the distance between parallel slope headings. Where panel slopes are used, they consist of a haulageway and a manway.

R. S. Robbins

Off the main haulage slopes, entries are driven either way at intervals of 450 ft. on a 1 percent grade favoring the loaded cars. A set consists of four parallel entries driven on 50-ft. centers, leaving a 300-ft. block between the top entry of one set and the bottom entry of the set above. (*See Plan "1."*) The first and fourth entry in the set are termed the breaking entries. The second is designated as the haulage entry, and the third as the aircourse. The haulage entry is driven 16 ft. wide to allow for double track, the other entries 12 to 14 ft. Crosscuts are driven at intervals of 250 ft. on slopes and entries, and slants 1,000 ft. apart between main and back entries.

Room and pillar workings, and also long-face workings, are developed in the 300-ft. block up the pitch. Rooms are driven from 30 to 35 ft. wide, on 60-ft. centers, off the haulage entry. Long faces are developed by driving 16-ft. rooms on 80-ft. centers, a 300-ft. face thus being provided. By this method the entire 300-ft. block is removed at the first mining, with the exception of about 10 ft. which is left as a protection for starting the next block.

Timbers of untreated native pine are set in both rooms and long faces, spaced about 4 ft. apart. Very few props or timbers are used in the entries. In long-face blocks, the props are left in place until the next adjoining block has been mined. They are then removed when the roof conditions will permit. Sometimes timber recovery is complete, but more often only partial recovery is possible. However, about 35 percent might be considered as average recovery.

The mines are ventilated by exhaust fans on the surface, which circulate considerably more air than is generally considered necessary for hand loading mines. The purpose of this is to furnish a maximum supply of fresh air to the auxiliary blowers, which are used to ventilate the working faces where the mechanical units are employed. So far, no gas has been discovered in the mine workings. However, the mines are rock-dusted according to Bureau of Mines standards, and each section isolated by the installation of standard dust barriers. In addition, all haulage entries are thoroughly sprinkled twice each week, and water sprays are placed in the intakes to supply moisture to the intake air, which is naturally light and dry. Water lines are laid to all working faces, water being used on the cutter bars of the mining machines. A water supply for this purpose is either piped in from the surface or taken from a reservoir in the mine, which is supplied by water from the slope bottoms.

All coal is undercut. Permissible powder is used exclusively. Efforts have not been concentrated on the production of a maximum percentage of lump sizes; nevertheless the amount of explosive used is restricted to the minimum required to break down the cut to sizes which can be handled without blocking the conveyors. Powder used averages 1 pound to 6 tons of coal. The final product at the tipple runs about 20 percent over a 6-in. screen, 40 percent over a 1⅝-in., and 40 percent through the latter.

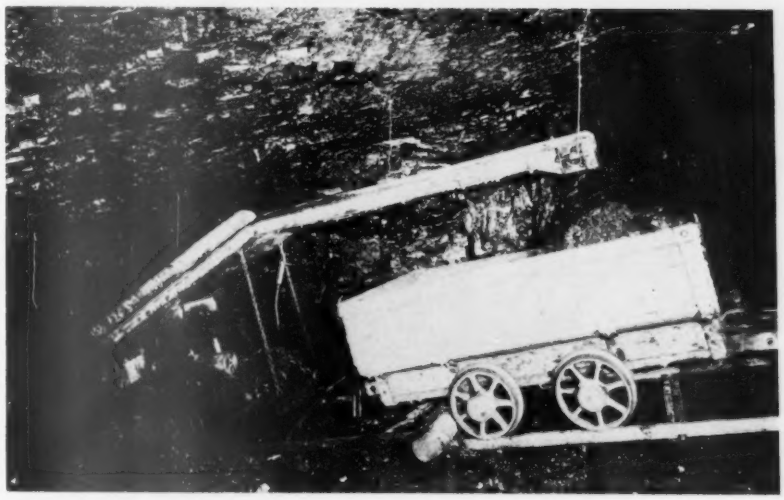
Thomas Foster

By THOS. FOSTER *

K. V. CAMMACK †

F. J. STORTZ ‡

RAY ROBBINS §



Loading with 4-BU Joy Loader in slope with 15 degree dip

Haulage is one of the most important factors in the successful operation of the loading units. To insure a continuous supply of empty cars to the loading end of the units, and to provide for the concentration of several units in one heading, haulage entries are double tracked, with a cross-over switch at each loading unit, except the entry driving unit. This arrangement is shown on *Sketch "A."* The top track is used for loading, the bottom track for motor haulage. Empties are shoved or chained past the loading end and dropped into loading position by gravity. Loads are dropped out in the same manner, and are picked up by the gathering locomotive at the next lower cross-over switch. In the case of the entry driving unit, the track is extended past the loading end, along the top rib, far enough to accommodate a number of empties. Thus the lower or main track is always open for the locomotive to bring up empties and gather a full trip of loads on the way back. Main partings are provided at the slope, where the loads are delivered to the main hoist, and the empties returned. Six-ton haulage locomotives are used, and these will accommodate from four to six loading units in one entry, depending on the length of haul. Mine cars average 1½ tons each, when loaded by machines.

The methods employed in the operation of both the No. 1 mine and the No. 3 mine are the same, and the coal from each is 100 percent mechanically loaded. It will, therefore, be necessary to follow the development and operation of the No. 1 mine only. Loading in this mine is accomplished by two types of loading units, namely, the 4-BU Joy loader and the Cosco or Eickhoff conveyor equipped with duckbill. The various methods used in driving slopes, entries, crosscuts, rooms, and long faces are here described in the order in which they appeared in the course of development.

On the completion of the 1,000-ft. rock tunnel from the No. 7½ seam to the No. 1 seam in 1927, it was decided to develop and operate the No. 1 mine on a mechanical basis. The tunnel intersects the No. 1 seam about 500 ft. down the pitch from the outcrop. (*See Plan "1."*)

One shaker conveyor was first installed and an aircourse run from the end of the tunnel up the pitch to the crop line. Three hundred feet were driven with the first set-up, and the conveyor then moved 75 ft. along the entry and a parallel manway driven up the same distance. At this point it became necessary to drive a crosscut between these two headings for ventilation. No practical method of operating a pan line at right angles to the main conveyor was known at this time, so it was decided to try a side drive, consisting of six 12-in. sheaves, some ⅝-in. rope, and four turnbuckles. (*See Sketch "B."*) This proved to be successful, and in like operations several hundred feet of entry and crosscut were driven by this means. The only trouble encountered was in rope breakage, which was later overcome by the substitution of a rod drive instead of the rope. (*Sketch "C."*) This drive is especially adapted to four-entry development where the drive is placed in the top breaking entry, and the loading end on the haulage entry. Another method was later devised to drive places off at right angles, and is accomplished with one pan line only. This is the three-swivel set up. (*See Sketch "D."*) This is useful in turning crosscuts and room necks from entries.

After a couple of installations were made, it was realized that the prevailing

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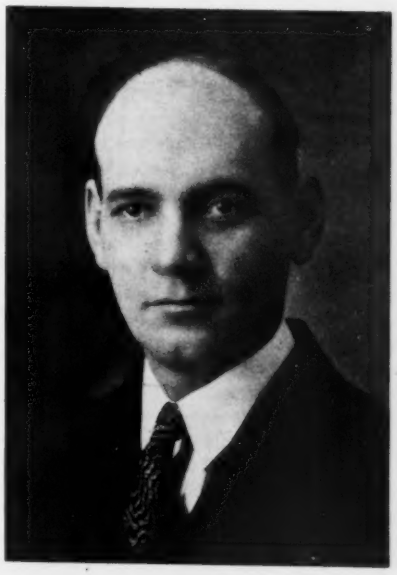
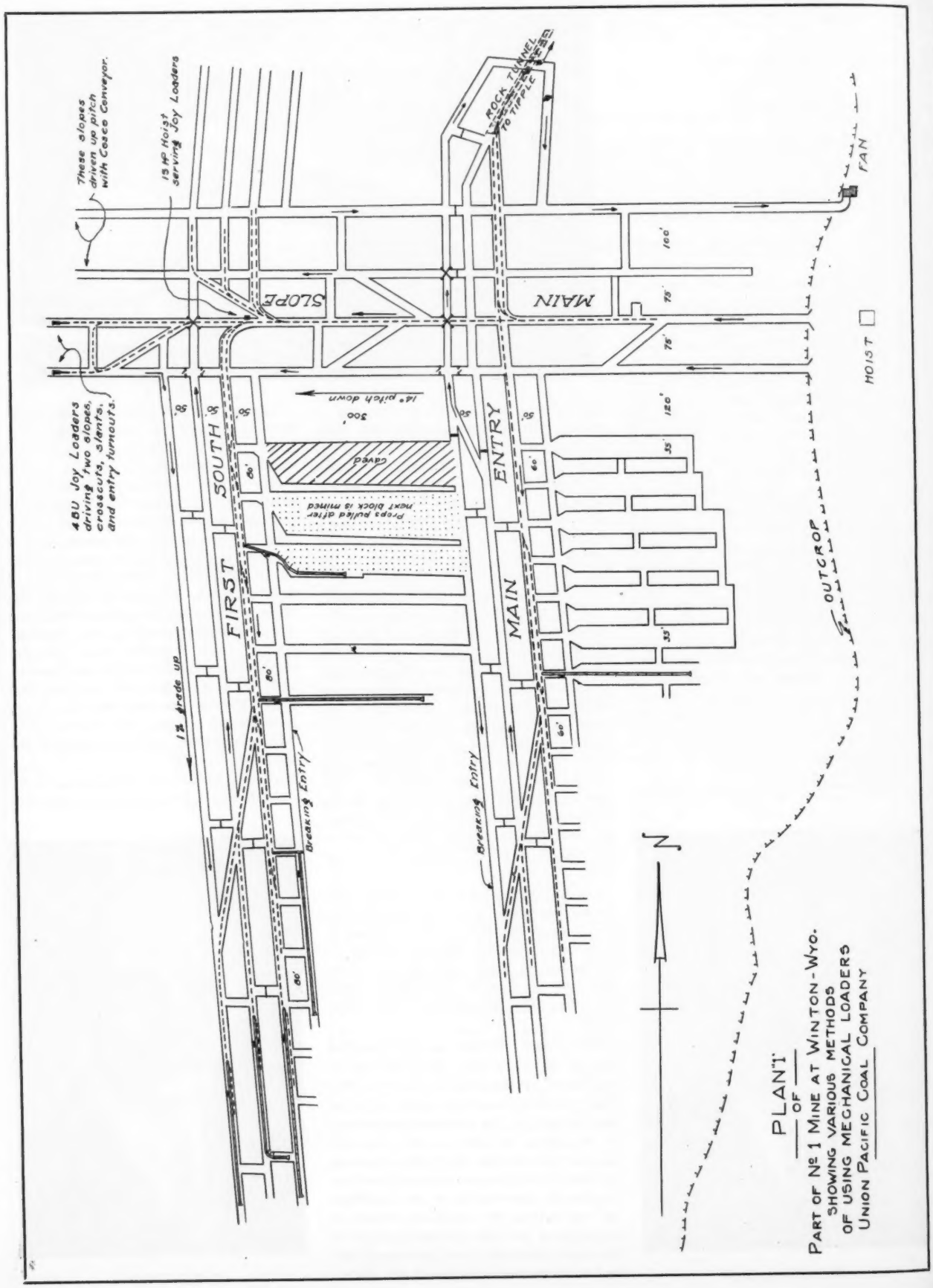
§ Resident Engineer, The Union Pacific Coal Co.

Kirk V. Cammack



Fred J. Stortz

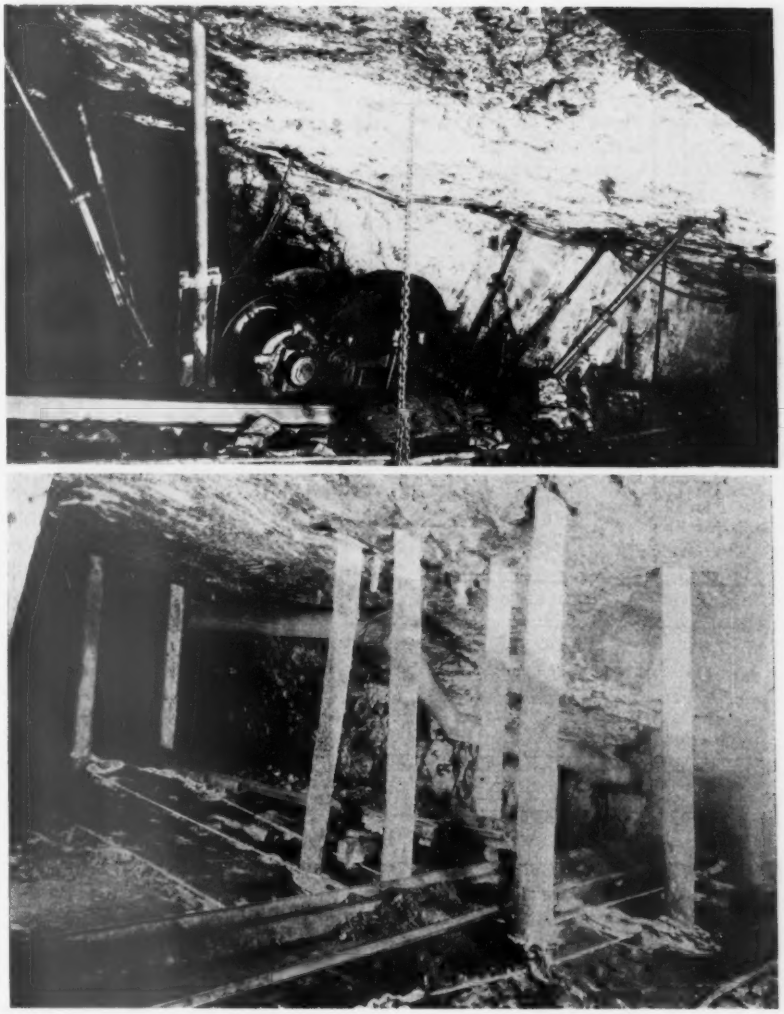

These slopes driven up pitch with Cable Conveyor.
15 HP Hoist serving Joy Loaders
ROCK TUNNEL
TO TIPPLE
FAN
SLOPE
MAIN
100'
75'
75'
HOIST
45U Joy Loaders driving two slopes, crosscuts, slants, and entry turnouts.
14° pitch down
300'
SOUTH
FIRST
ENTRY
MAIN
120'
55'
60'
55'
60'
Caved
Props pulled after next block is mined
OUTCROP
13% grade up
Breaking Entry
Breaking Entry
N
PLAN
OF
PART OF No 1 MINE AT WINTON - WYO.
SHOWING VARIOUS METHODS
OF USING MECHANICAL LOADERS
UNION PACIFIC COAL COMPANY

Set up of Cosco Drive with 6 Jackpipes

methods of setting up drives with props was costly and inefficient, and metal screw jacks were made to replace the props. These jacks were made of a piece of 2-in. pipe of double strength and of the desired length. The pipe is pointed at one end and a 1¾-in. hex nut welded on the other or open end. A thread bar of 1¾-in. round mild steel with standard thread, and pointed on one end, is used. Hinged handles are welded to the side of the pipe for tightening against the roof. These jacks proved amply strong for the desired use, and greatly simplified the moving and setting of the drives.

It was also realized that if some device could be made that would hold the pan line swivels firmly in place, it would be possible to turn the pan line from the direct line of drive and deflect the pan motion on an angle. For this purpose a piece of 2½ x ½-in. flat iron 4 ft. long was used. A collar was made on one end, large enough to allow a screw jack to slip through, and a hinged clevis on the other end to couple onto the connection of the swivel and pan. This combination of screw jack and stiff arm became known as a bridle jack on account of its use in guiding the pan line. When this device was connected to the swivel and the screw jack set firmly in place, it was found that it was possible to turn the pan line, as much as 30 degrees off its previous course without impairing the conveying motion. It then became apparent that the pan line might be turned to any angle merely by adding swivels and pans with accompanying stiff arms and jacks, until the desired angle had been reached. To facilitate the turning of the pan line in small areas, shorter pans, 4 to 6 ft. in length are used. If it is necessary to carry more than eight pans ahead of this swivel set-up, a heavier jack arrangement is used. This consists of a base made of ½-in. boiler plate with the corners turned down to grip the bottom, and a clevis in the top to attach the stiff arm. A screw jack is then set on each corner of the base in holes made for that purpose. This makes a very rigid set-up. It has also been demonstrated that by attaching a swivel to the drive pan, the pan line can be operated in a different direction than the entry line.

After the preliminary work from the rock tunnel had been finished, three more shaker conveyors were installed and four entries were driven to the crop line. (*Plan "1"*.) Rooms were necked at 60-ft. centers on the haulage entry, and 35-ft. rooms driven up the pitch to the crop line with a shaking conveyor and duckbill attachment. The coal in this area was found to be 12 ft. in height with a boney parting 5½ ft. below the roof. At first an attempt was made to take the entire 12 ft. on the advance up the pitch. This, however, proved to be dangerous practice as the face had a tendency to fall away from the roof when undercut. It was then decided to mine the bottom coal up to the parting until the room was finished and then take the top coal on the retreat. This proved satisfactory and this method has since been used in all high coal.

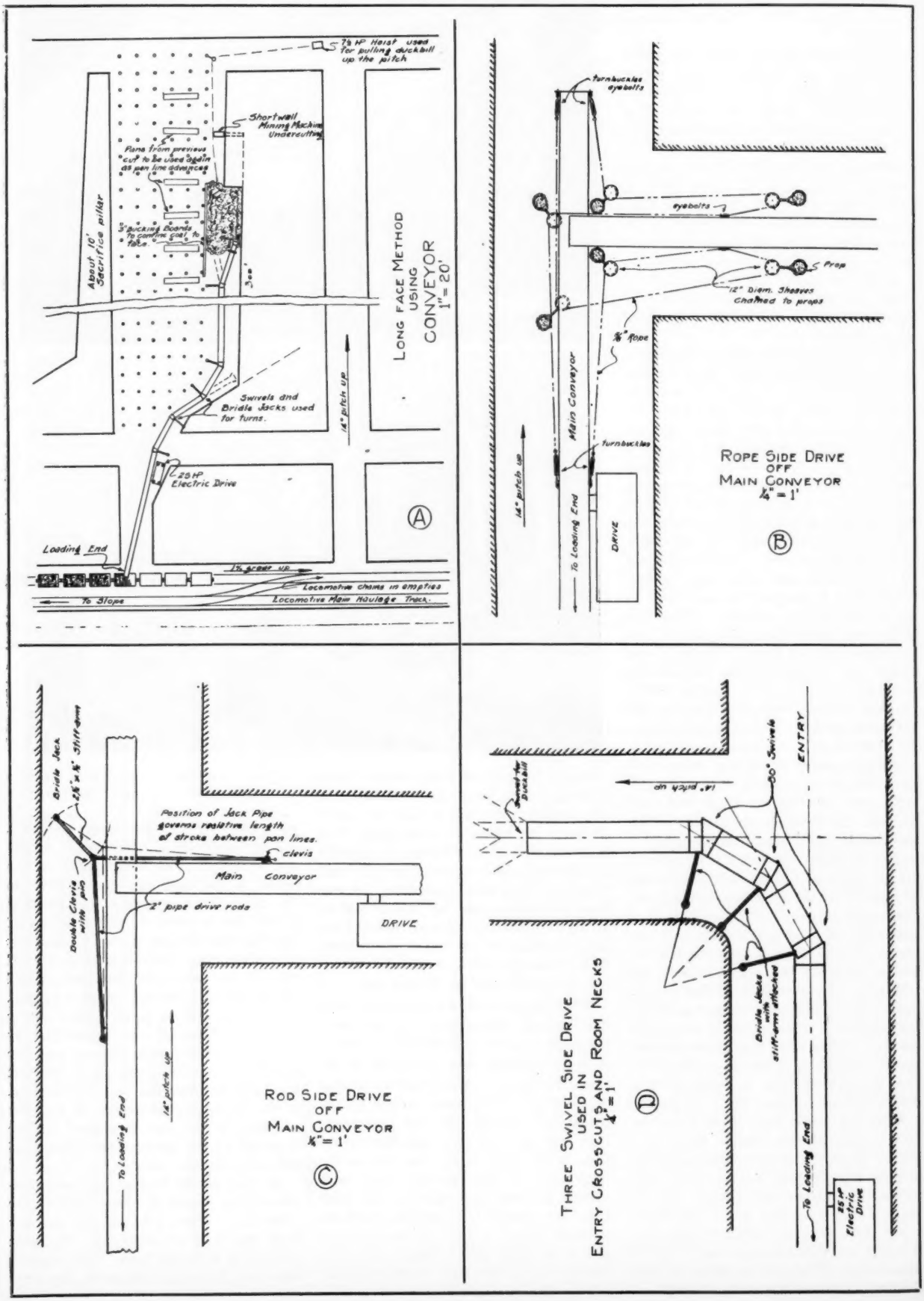


Shaker Conveyor with right angle rope drive

While the first set of entries was under development, slopes were started down the pitch to open up additional territory. A flight conveyor was first tried in the slope, and then a shovel loader. Owing to the pitch of the seam neither proved successful. An old 4-BU Joy loader was then secured, and gave satisfactory results in the slope work. As soon as the usefulness of this machine had been proven, another was placed in the back slope and a small D. C. sinking hoist set to serve them. A crew of five men was placed on each shift. Each crew consisted of a Joy operator, roperider, hoistman, machine man and machine helper.

The face cycle of operation is as follows. The Joy is first placed in the center of the slope and worked down to the face. The hoist rope is then attached to the Joy to assist in pulling it out of the face and shifting it over to the right side of the slope. Here, it is again worked down to the face, pulled back and shifted to the left side, which is cleaned up last. Such slack coal as is not picked up by the Joy, is shoveled onto the machine by the operator and rope runner, and the Joy is then pulled back along the left hand rib to clear the face for cutting. While the loading process is on, the rock or bone in the coal is picked off the conveyor by the operator and helper and gobbed along the rib.

As soon as the loading has been completed, the operator moves over to the other slope, where a fall of coal is ready to be loaded by the other Joy. The same process is repeated here. The machine man and his helper follow in the slope


7½ HP Hoist used for pulling duckbill up the pitch
Shortwall Mining Machine Undercutting
Pans from previous "cut" to be used again as pan line advances
3" bucking Boards to confine coal to face.
About 10' Sacrifice pillar
30'
Swivels and Bridle Jacks used for turns.
14° pitch up
25 HP Electric Drive
Loading End
1½ grade up
Locomotive chains in empties
To Slope
Locomotive Main Haulage Track.
LONG FACE METHOD USING CONVEYOR 1" = 20'
Ⓐ
turnbuckles eyebolts
eyebolts
Prop
12" Diam. Sheaves Chained to props
⅝" Rope
Main Conveyor
turnbuckles
14° pitch up
To Loading End
DRIVE
ROPE SIDE DRIVE OFF MAIN CONVEYOR ¼" = 1'
Ⓑ
Bridle Jack
1¼" x ¼" Stiff arm
Position of Jack Pipe governs relative length of stroke between pan lines.
clevis
Main Conveyor
Double Clevis with pins
2" pipe drive rods
DRIVE
14° pitch up
To Loading End
ROD SIDE DRIVE OFF MAIN CONVEYOR ¼" = 1'
Ⓒ
Duckbill
14° pitch up
60° Swivels
ENTRY
Bridle Jacks with stiff arms attached
To Loading End
25 HP Electric Drive
THREE SWIVEL SIDE DRIVE USED IN ENTRY CROSSCUTS AND ROOM NECKS ¼" = 1'
Ⓓ

just cleaned, load out the rock that has been gobbed, cut, drill, and shoot the face. The Joy is pulled back well above the fall before shooting. Steel ties and 20-lb. steel are used for advance track work, and this is relaid with 40-lb. steel every 75 ft. gained.

In 15 months of operation with two Joys, 1,500 ft. of slope and 1,200 ft. of crosscuts and entry turnouts have been driven. A reduction of 50 percent in the cost has been effected between mechanical operation in this work and hand labor paid on a scale basis. The only difficulty in the maintenance of these machines was found in keeping the clutch on the gathering head in working order. This was remedied by shortening the picks until they barely cleared the edge of the loading head, so they could not catch in the solid face.

As soon as new entries are gained by the progress of the slope, shaking conveyors with duckbills are installed and double-shifted. Four men comprise a conveyor crew in this operation, three men at the face, and one at the loading end. This crew carries out the entire cycle of cutting, drilling, shooting and loading, a certified shot-firer working on each crew. Twenty-eight ft. is an average advance for a double shift in this work.

In the 35-ft. rooms driven up the pitch, the crew consists of five men. A machine man, helper, ratchet man, face man, and a man at the loading end. Assuming a full fall of coal to be at the face, the cycle of operation is as follows: the duckbill is swung over to the right hand side of the room and the loading started. As soon as the right side is cleaned of coal, the machine man and his helper sump in and follow the duckbill across the face, drilling as they cut. When the duckbill reaches the left-hand corner of the room, and the entire face is cleaned up, it is detached from the panline, and pulled back across the face of the room by the mining machine. A 6½ or a 13-ft. pan, as the case may be, is attached to the end of the panline. The cutting machine is pulled back to the right-hand rib of the room out of the way and the line of props extended. The man at the loading station, having prepared the powder and tamping, disconnects all power lines to the face, brings up the powder, and loads, tamps, and shoots the face. The loading process again starts in the right-hand corner of the room. One hundred and eighty tons, for a double shift, is the average in this work, although a record of 270 tons has been made.

It has ever been the desire, to work out some scheme whereby all the coal, or as much of it as possible, can be extracted at the first mining. For this purpose a long face method has been developed and is being worked successfully. (*See Sketch "A".*) This has also proven advantageous in handling the roof in sections where bad top is encountered. The procedure is as follows:

A 16-ft. plane is driven up the pitch to the breaking entry above, using a Cosco conveyor as in room work. However, the drive is set cornering the long-face block to be mined. The duckbill is then pulled down to the bottom of the plane, the 300-ft. face on the right undercut from top to bottom, and props set 3½ ft. from the face, with a 3-in. plank barrier nailed to the prop line opposite that part of the face which is to be shot down. This is done to prevent the coal from scattering amongst the props.

The crew consists of four men on the day shift and two men on the night shift. The day men are the duckbill operator, a timberman, and two face men, whose combined duty it is to load out the coal. The night shift is composed of a machine man and helper, who do the cutting, drilling, shooting, and the deadwork.

About 100 ft. of face at the lower end of the block is then shot down. The duckbill is turned into this and the loading commenced. Usually three loading shifts suffice to clean up the 300-ft. face, about 150 tons being the average daily output. The pans used in driving up the plane are left in convenient positions where they may be readily picked up and used again in the line as it advances up the pitch. The pan line is kept far enough from the face to allow room for the cutting machine to follow up the loading. Pan changes require from 3 to 10 minutes, quick connectors being used. Turns are made by the use of swivels held firmly in place by bridle jacks. A small hoist is set in the breaking entry above for the purpose of pulling up the duckbill when pan changes are necessary. Thus an 80-ft. block is mined with one setting.

While this block is being mined a second conveyor is engaged in driving up the plane in the next adjoining block. When the long face approaches to within about 10 ft. of this plane, it is considered finished, a 10-ft. sacrifice pillar being left to protect the next plane. The first conveyor is then removed and installed two blocks ahead, and the second conveyor starts on the long face off the plane it has just driven.

Thus, mechanical loading has been developed in this mine to a point where a dependable tonnage is maintained, and a substantial saving in cost effected.

MECHANIZATION AT HANNA

(*From page 108*)

a start in a minor official capacity he should be provided with every opportunity to better his education.

The Union Pacific Coal Company has night schools for all employes during the entire winter in which any subject concerning mining can be taken up. These schools are taught by engineers from the chief engineers department and by the operating officials. Frequent staff meetings and meetings of local mine institutes affords every official the opportunity of broadening out his knowledge of mining.

The human side of mining is still the most important and the selection and promotion of officials is a field of almost unlimited possibilities. The mine superintendent who can select and train the proper kind of underground officers need not worry about his machines or his costs for his gang will take care of such things for him.

MECHANIZATION AT ROCK SPRINGS

(*From page 121*)

by the loading point as desired. The tracks on the haulage entries are laid with 20-lb. rails, and 4-ton electric locomotives are used for hauling the coal from the sidings or partings to the slopes.

The tracks on the slopes are laid with 60-lb. rails, and the coal is hauled from the sidings at the slope up the pitch to a landing station by electric hoists, equipped with motors ranging in capacity from 150 to 250 hp. The main haulage entry from the top of the slope to the outside has an inclination of about 1 percent in favor of the loaded trips, and the track is laid with 60-lb. rails. A 15-ton electric locomotive is used for hauling the coal from the landing station to the tipple, a distance of approximately 6,000 ft., 50 pit cars being hauled to the trip, approximating 100 tons per trip. The tipple is of wooden construction, equipped with rotary dump, a three-track shaking screen, and has a capacity of 3,000 tons in eight hours. The pit cars are of the solid body type, of steel construction, capacity 4,500 pounds level full, the track is 36-in. gauge. Slate pickers are employed on the shaking screens and on the railroad cars, and the coal is prepared reasonably free from slate or bone.

The coal seam in the mine referred to is normally 8 ft. in thickness and pitches approximately 8 degrees. The seam is free from bands or impurities, with the exception of a rock band about 18 in. from the roof, which varies in thickness from 1 to 3 in. The roof directly overlying the coal seam is of hard shale, of which is also the floor directly underlying the coal seam. The headings and conveyor ways are driven a height of 6 ft. 6 in. under the rock band, and when the blocks and pillars are won the 18 in. of top coal is recovered. The working places are dry, and the amount of water encountered is not more than sufficient to keep workings in a damp condition.

ELECTRIC POWER for The U

By D. C. McKEEHAN *

Central power plant for Rock Springs group—Description of boiler room, power house, water cooling system, transmission lines, transformers, underground sub-stations, underground feeder lines

NEARLY all methods for increasing coal productions and at a decreased cost require the use of electric power. The innovation of mechanized coal mining requires that the electric service be almost infallible, in order to coordinate into a continuous process the several operations from loosening the coal in the solid to that of placing it into the railroad cars for transporting.

In 1918 the electrification of all the mines in the Rock Springs field was completed and the total load has been carried by the Rock Springs power plant since that time. The plant, as it stands today, is an outgrowth of what has gone before, when steam was the only available source of power, consequently we find the boilers and turbines in separate buildings. The space between the two buildings was occupied by a steam hoist, which has since been dismantled, and which served the mine that supplied the boilers with coal.

The boiler room contains 12 Babcock and Wilcox water-tube boilers, having a total rated capacity of 3,408 hp. at 150 lbs. pressure, fitted with both chain-grate and type E stokers and superheaters for 100 degrees superheat. Duplicate steam lines lead from the boiler room to the turbine room. Slack coal and machine cuttings are burned exclusively, being delivered from railroad cars to storage bins by an elevator and belt conveyors. Six boilers with chain-grate stokers are provided with induced draft motor-driven fans and the six boilers with type E stokers are provided with a steam-driven fan and an auxiliary motor-driven fan. Usually the steam-driven fan is run in order to supply exhaust steam to the feed-water heaters.

Ashes are handled with a minimum of labor and are flushed from the boiler

* Chief Electrician, The Union Pacific Coal Company.

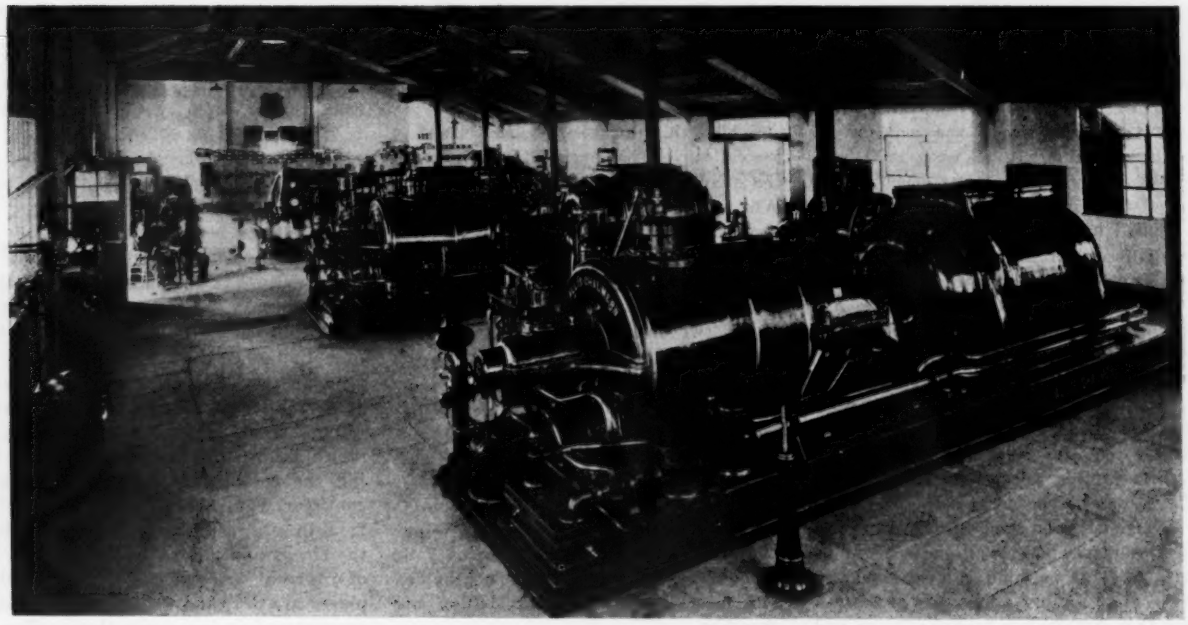


Figure 1. *Interior of Power Plant at Rock Springs*

Union Pacific Company Mines

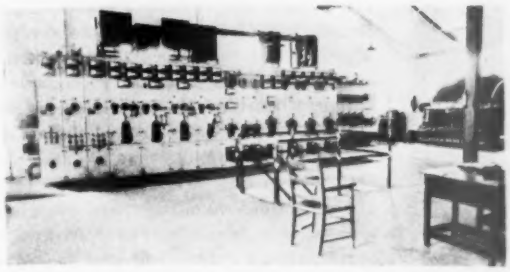
pits by mine water to centrifugal pumps that discharge them into a near-by creek. Water for supplying the boilers is obtained from a series of wells operated by an air-lift located about a mile from the plant. Storage tanks on a hill back of the plant provide an adequate supply at a very good pressure. Boiler feed water is taken directly from the cooling pond at an average temperature of about 75 degrees F. and is fed to the boilers without softening treatment.

The turbine room, shown in *Figure 1*, contains three 2,500-kw. turbo-generators and one 1,000-kw. capacity, delivering 2,300 volts, 60-cycle current at 3,600 revolutions per minute. The turbines exhaust into jet condensers. Air removal from the condensers is accomplished by reciprocating vacuum pumps and air ejectors. The cold-water circulating pumps are driven by both induction and synchronous motors and are supplied at 2,300 volts, thereby eliminating transformers. The matter of using synchronous motors for auxiliary drives at bus potential is often questioned by designers of power plants; however, our experience does not condemn their use, although the motors are not of most recent design. As a matter of safety, all 2,300-volt motors within the plant are equipped with remote controlled automatic starting compensators.

The switchboard shown in *Figure 2* has been rebuilt several times during the past 10 years in order to accommodate the increased load. Larger oil circuit breakers have been necessary to interrupt severe short circuits and a double bus permits of repairs without a plant shut-down.

The cooling pond shown in *Figure 3* is approximately 30,000 sq. ft. in area and averages 30 in. in depth. The water is sprayed through 375 spray nozzles, which reduce the temperature about 14 degrees F. in summer and 18 degrees F. in winter during the time of the day of the greatest load.

Power is supplied to the towns of Rock Springs, Reliance, Gunn, Dines, Winton, and Superior, serving a population of about 15,000 persons. Power sales to the independent companies are handled by a subsidiary, the Southern Wyoming Electric Company. Mines in the vicinity of the plant and the town of Rock Springs are supplied at 2,300 volts. A 13,200-volt circuit supplies the town of Gunn, Gunn-Quealy Coal Company, and the Megeath Coal Company, both of which are not a great distance from the plant. This line also extends to the power plants of the Central Coal



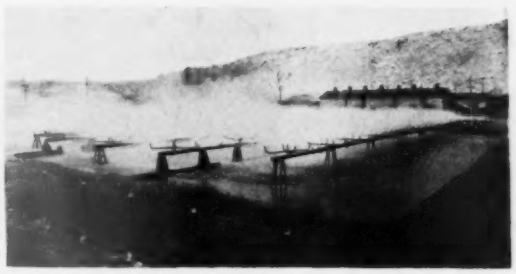
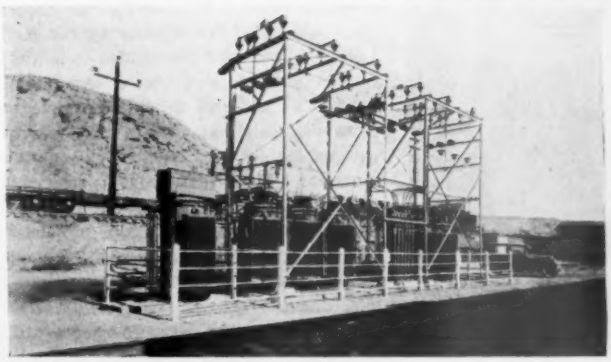


Figure 2 (Left)—Switchboard.

Figure 3 (Right)—Cooling pond.



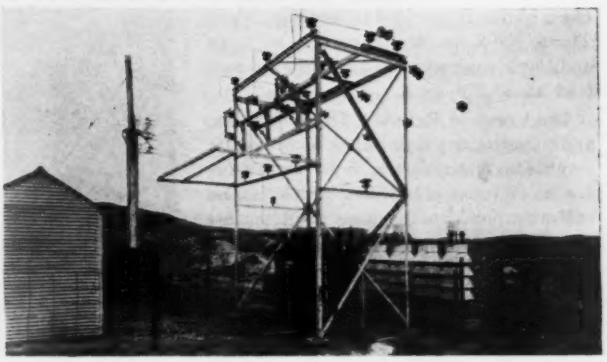


Figure 4 (Left, above)—33,000-volt set-up transformers at power plant.

Figure 8 (Right, above)—One of the 33,000-volt outdoor sub-stations.

Figure 5 (Right)—Vertical suspension for bore-hole cable.

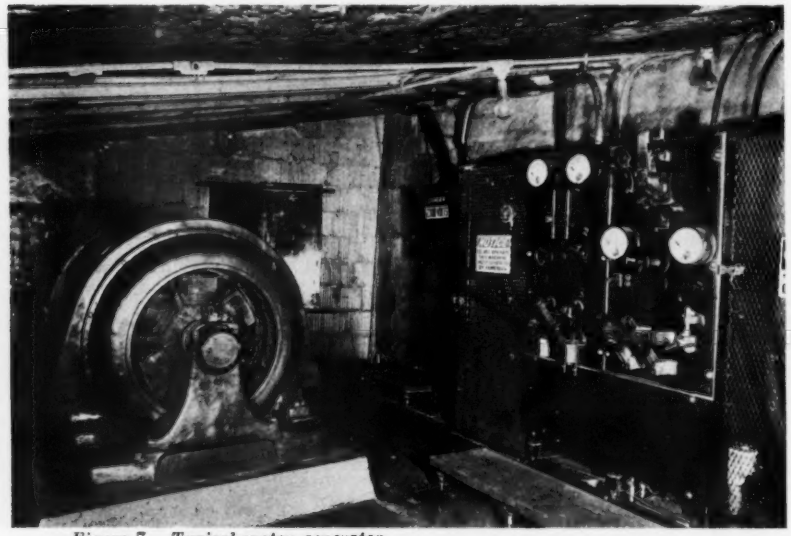


Figure 7. Typical motor generator installation.

and Coke Company and the Lion Coal Company, each having 1,000 kw. installed for emergency service or for the purchase of power in the usual way, at their discretion. It is possible to operate the three plants in parallel if occasion arises. Three 400-k.v.a. transformers, with an additional spare unit, handle the present load at 13,200 volts.

The towns of Reliance, Dines, Winton, and Superior are supplied at 33,000 volts. Duplicate transmission lines extend as far as Winton, 11 miles, which is the half-way point to the town of Superior. Transfer switches are arranged so that any mining district may be supplied over either line, which greatly facilitates in keeping the load on the lines balanced.

Figure 4 shows the 33,000-volt step-up transformers at the plant, consisting of six k.v.a. units in two delta banks and one transformer for a spare. The total connected load is in excess of 23,000 hp. in alternating current motors. Maximum load on the plant reaches 8,000 kw. The ratio of peak load to connected load is one-third, a figure often desired by coal and electric utility operators. The annual load factor referred to plant capacity is about 25 percent.

Approximately 13,300,000 kw.h. were used by the company during 1928 in mining 2,155,824 tons of coal in the Rock Springs field, an average of 6.1 kw.h. per ton of coal mined. In 1925, previous to the days of mechanized mining, the average was 6.18 kw.h. per ton, showing that mechanization has not altered the power consumption to a great extent. However, this is accounted for by concentrated workings, better track bonding, and improvements in all the facilities

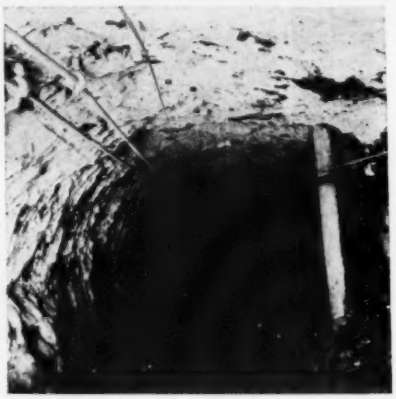


Figure 6. Method of supporting 2,300-volt cables and 250-volt D. C. feeders.

that enter into the transmission of power to the working face.

Synchronous motors are used extensively in order that the plant may operate with a good power factor commensurable with the load. A power factor varying from 90 to 95 percent, lagging, is maintained during the working shift. The larger installations consist of three hoists driven by 550-hp. motors and two hoists driven by two motors of 300 hp. each, not to mention numerous hoists of 400 hp. and smaller.

At the several mines the voltage is reduced to 2,300 volts for general distribution and to supply the larger motors. For a number of years it has been our practice to use 2,300 volts at the motors as much as possible in order to eliminate transformers and the potential fire and smoke hazard of the oil. In making 2,300-volt installations the matter of safety is given the first consideration. All live parts are enclosed in metal casings so that they are inaccessible to unauthorized persons. The matter of grounding motor frames, oil circuit breakers, conduits, etc., and in fact all parts that may become charged due to defects, is closely watched at time of installation and subsequent inspections.

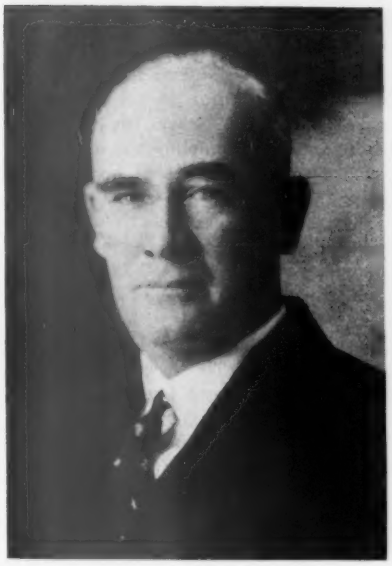
The only transformers in the mine are small ones for operating control equipment and for supplying a limited amount of electric lighting at motor-generator stations, pump rooms, hoists, and partings where it is advisable to have the lighting independent of the direct-current lines. Power is carried into one of our largest mines by a 2,300-volt cable through a 500-ft. bore hole. The cable is made up of three 0000 B. & S. conductors, lead covered and is wire armored for vertical suspension. *Figure 5* shows the method of fastening at the surface. Many of our mechanical loading installations are of a temporary nature requiring that they be moved quite often. In some cases once a month, and others every year or two.

Cables to best withstand 2,300 volts and numerous handlings are made up with rubber insulation over each conductor, then a rubber belt over the three conductors quite the same as the rubber-clad cable used for mining machines. A layer of jute over the rubber belt and a double steel tape protects the interior rubber. The steel tape is grounded at intervals as a safety measure. Underground cables are suspended on steel messenger wire fastened to props quite similar to aerial telephone cables on poles. *Figure 6* shows the method of supporting 2,300-volt cables on right and the 250-volt direct-current feeders on the left.

Motor-generator sets are used for the conversion from a. c. to d. c. in preference to rotary converters, and but two rotaries are in operation. The factors determining the selection of motor generators are: Elimination of transformers, especially underground; better facilities for carrying leading current for power factor correction at all loads and ease with which temporary repairs may be made to tide over an emergency. They are installed in fireproof rooms built of hollow tile or concrete, and whenever possible are located between intake and return air courses in order that smoke and fumes, in case of a burnout, may be diverted to the return air course instead of following the main air current. Automatic reclosing circuit breakers are used extensively to sectionalize parts of the mine and to limit the amount of power that can flow into a short circuit in case of trouble. Typical motor-generator installations are shown in *Figure 7*.

MACHINE INSTALLATIONS

Surface and underground hoists—Recent installations on inside slopes—Rope maintenance and inspection—Man trips—Main and gathering locomotives—Main and gathering pumps—Automatic control



By A. T. HENKELL *

IN USE at present as main hoists at the various Union Pacific Coal Company properties in Wyoming there are five electric hoists ranging in horsepower from 500 to 600, four ranging from 300 to 400, and eight ranging from 150 to 300. These hoists are all electric motor driven and have single reduction herringbone gears.

Electrification has rapidly replaced the steam hoists formerly used, but there are still in operation as main hoists three of the first motion steam hoists at properties where electricity is not yet available in quantity. One at Hanna mine No. 4 is an 18 in. x 48 in., one at Hanna No. 2 mine is 24 in. x 48 in., and one at Cumberland No. 1 mine is 32 in. x 60 in. This Cumberland hoist established a record for Union Pacific properties in early days by hoisting 3,112 tons in a 10-hour day.

The most recent hoist installations have been made at the No. 8 mine in Rock Springs. The coal from the lower levels at this mine must be hauled approximately 2 miles to the tipple, part of the distance by electric hoists and balance by electric locomotive haulage. Two electric hoists are used, one hoisting from the lower levels as a sub or gathering hoist places the coal at 9 entry. From this point the coal is hoisted 3,400 ft. to the upper parting, from whence it is hauled 5,000 ft. to the tipple by a 15-ton electric locomotive. The sub or gathering hoist manufactured by the Vulcan Iron Works of Denver is designed for 20,000 lbs. rope pull at 1,500 ft. per minute. On account of this hoist being used underground, an attempt was made to reduce the floor space required and to have all parts of a size readily transportable. The main gear is of split construction and will have power applied at two points, a 300-hp., 900-r. p. m., 2,200-volt motor at front and one at rear of hoist. This allows the use of a lighter gear and motors which can be transported without being taken apart. Only one motor is used at present on account of the short haul, half-size trips (eight cars) being hoisted.

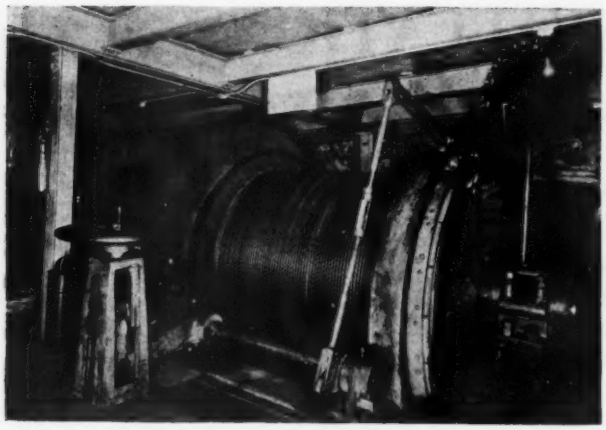
The drum is also of split construction. It is 62 in. in diameter and has a 72-in. face and is capable of holding 6,000 ft. of 1⅛-in. rope. The drum is bolted directly to the main gear placing the drive from the gear to the outside of the drum, allowing the use of a lighter drum shaft by eliminating the torsion from the shaft and the keys. The shaft is carried in two main bearings. A heavy compound is used on the gear faces as the elimination of the third bearing precludes the possibility of an oil-tight gear case. The brake is of the post type, using asbesto-metallic shoes, and is hand-wheel operated. This hoist does not have a friction clutch. Dynamic braking is used on the lowering of trips. The electrical equipment is of full magnetic control type, time-limit contactors being used. The resistance and contactor panels are placed in a room adjoining the hoist, and all leading wires are in conduit. The hoist room is steel timbered and both rooms are fire-proofed by cement ceiling and walls.

The upper or main hoist manufactured by the Nordberg Company is located on the surface approximately 1,100 ft. up the 8-degree pitch from the upper parting or landing. To avoid placing this large hoist in the mine and to provide an extra airway, as well as an outlet for rock disposal, this place was driven through rock and earth to the surface. This hoist is designed for 12,000-lb. rope pull at 1,500 ft. per minute, with drive through single reduction herringbone gears. The main gear and drum are of split construction. The drum shaft is carried in three main bearings and the drive is through shaft and keys to the drum. An oil-tight case encloses the gears. The drum is 72-in. diameter with 84-in. face and is capable of holding 8,000 ft. of 1⅛-in. rope. This length of rope allows mantrip to be hoisted from lower levels and also allows switching of material on idle days without the use of sub or gathering hoist. This hoist is not equipped with friction clutch, and dynamic breaking is used in lowering trips. An oil-operated post brake is used for stopping and starting. The motor used is a 550-hp., 600-r. p. m., 2,200-volt, and is operated with full magnetic control. The trip hoisted consists of 16 3-ton cars.

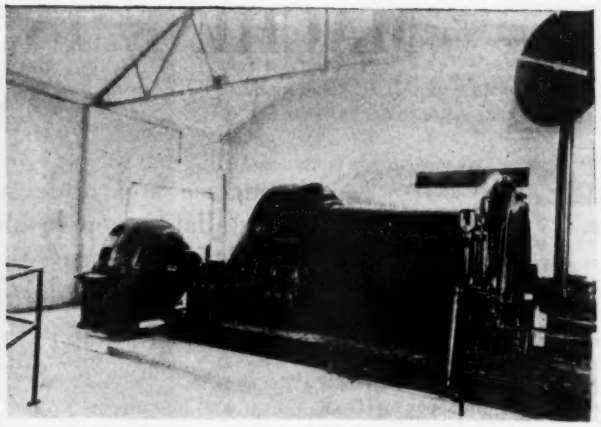
In the sinking of slopes and other narrow work, double reduction geared hoists ranging in horsepower from 15 to 35 are used. These hoists are equipped with direct-current motors, except in the Cumberland field, where direct-current power is not available.

In panel work, hoists ranging from 50 to 250 hp. are used. These are all driven by 2,200-volt a. c. motors, and all except the 200 and 250 sizes are of double reduction gearing. One 250-hp. hoist is located at "G" plane, Hanna mine No. 4, and is used in hoisting coal from the Thew shovels and the shaking conveyors. It is geared for a rope speed of 1,050 ft. per minute hoisting coal on a 14-degree pitch. It is equipped with two hand-operated post brakes and has a band clutch.

* General Master Mechanic, The Union Pacific Coal Company.



Sub or gathering hoist, No. 8 Mine, Rock Springs



550-hp. Nordberg hoist, main hoist, No. 8 Mine, Rock Springs

A number of 7½-hp. Treadwell hoists are used for dragging material for scrapers and shaking conveyors, and in some instances as room hoists.

LOCOMOTIVES, MAIN AND GATHERING

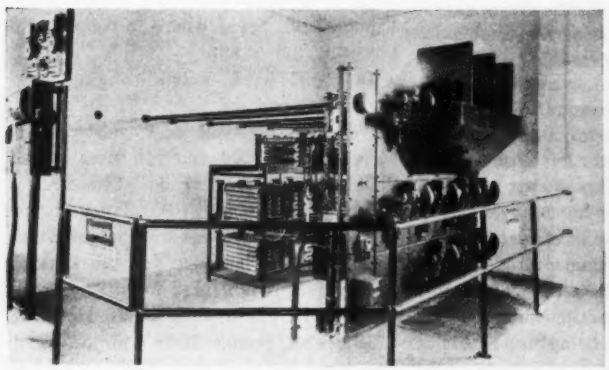
Electric locomotive haulage has long been a method of transporting coal in the mines of the Union Pacific Coal Company. The first electric locomotive was purchased in May, 1892, and was of the Terrapin Back type, weighing 9 tons, capacity 60 hp., and having a speed of 8 miles per hour. This was in continuous operation on 30-in. track gauge until about three years ago, when 500-volt direct current was replaced by 250-volt as a safety measure. It was used for approximately 34 years, and since being taken from the mine it has been given a coat of paint and now occupies a position of prominence on a concrete pedestal in front of the new Old Timer's Building. The purchase of this locomotive was followed by purchases of locomotives of 3, 4, 6, 8, and 10-ton capacity until all entry haulage is handled in this manner. The 3 and 4-ton locomotives are used on some entries for gathering, and are used in some of the rooms in Hanna mine No. 4 for hauling coal from the scrapers and the Thew shovels. The 6, 8, and 10-ton are used for entry haulage. Recently three 15-ton locomotives were purchased from the Goodman Manufacturing Company for main haulage. Two of these are at present handling the entire output of the mines at which they are located. One at No. 8 mine, Rock Springs, is used on 36-in. gauge track, has a wheelbase of 66 in., and travels at a speed of 8 miles per hour. It is equipped with two 90-hp., 250-volt, d.-c. motors and has dynamic braking control. This locomotive handles coal from the upper landing in No. 8 mine on an underground haulageway 5,000 ft. to the tipple, hauling approximately 2,300 tons per day, each trip consisting of 48 3-ton cars.

SLOPES, INCLUDING TRACKS, ROLLERS, SHEAVES, STANDS, ROPE TERMINAL ASSEMBLIES, ROPE MAINTENANCE AND INSPECTION, MANTRIPS

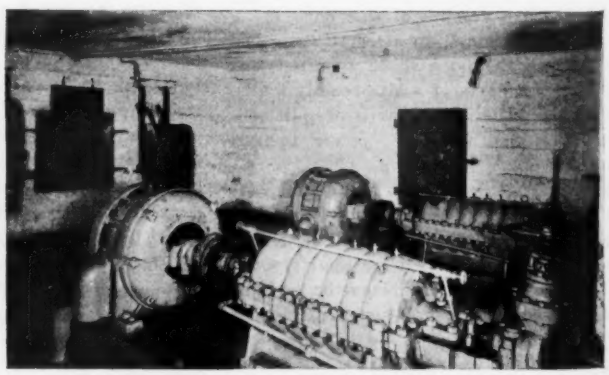
All hoisting operations are confined to slopes, no shafts being used at present. Coal is hoisted in the different districts on pitches ranging from 6 to 36 percent. Track gauges range from 30 to 42 in. Sixty-pound steel is used on the main slopes, with 40 to 60-lb. steel being used on the main locomotive haulage. In the panel operations 40-lb. steel is used on the slope and 20 is used on the entries and rooms.

Eight-inch diameter bell mouth, plain bearing cast iron rollers, and 5-in. diameter pipe rollers with grease-packed Timken roller bearings are used on the uniform portions of slope, while a home-made roller consisting of two discarded pit-car wheels welded together, with flanges at outer edge, are used on the slight knuckles and on the curves as side rollers. These are usually equipped with roller bearings. On the main rope carriages 12 in., 24 in., and 48 in. diameter sheaves are used, a typical installation being shown on the photograph of No. 8 mine main hoist house. Cast-iron sheaves are gradually being replaced by manganese on the heavier loads.

Hoisting ropes range from ½ to 1⅜ in. The ½-in. is used on the small sinking operations, while the 1⅜-in. is used on the 36 percent pitch at Cumberland. Ropes are purchased upon recommendations of the manufacturers and are usually 6 x 19 regular lay for the main hoists, while 6 x 8 lang lay is used on the panels, where the rope is subjected to a great deal of abrasion. On the long plane at Reliance a ¾-in., 6 x 19, regu-



Contactor and switch panels, 550-hoist, No. 8 Mine, Rock Springs



Main pump room, No. 4 Mine, Rock Springs

lar lay, Independent wire rope center rope is used. This rope is approximately 13,000 ft. in length. The fastenings used on all ropes are of the usual drop-forged type rope socket and swivel. On the heavier hauls these fastenings are coupled together with clevises instead of the ordinary welded links, and the socket is placed with zinc. A safety clevis with spring lock is used in attaching the rope to a trip.

A monthly report on condition of ropes and fastenings is made by the master mechanic in charge, and all fastenings, including the rope socket, are removed for annealing each four months. Main ropes are greased at weekly intervals, while the panel ropes are allowed to run two weeks between greasings.

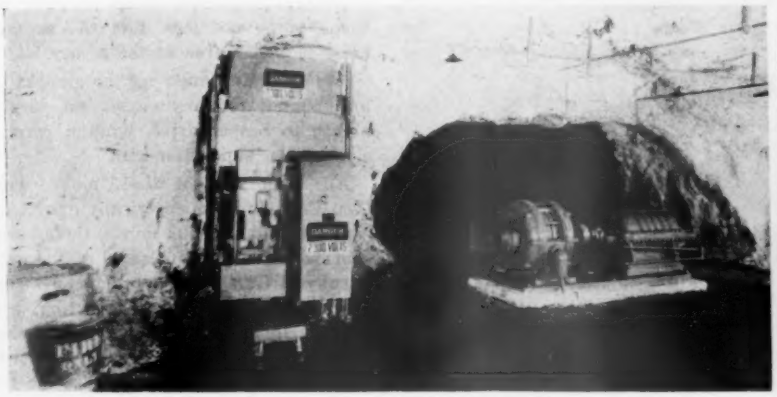
through the bumper, a spring cotter is inserted to keep them in place. A heavy cable is doubled through the cars, the loop being placed under the drawbar on the rear car. Both ends of this heavy cable at the front car are fitted with sockets and chains for attachment to the hoist rope fastenings. On the heavier pitches a small attachment is placed on the main rope, in much the same manner as a rope socket, about 24 in. ahead of the rope socket. This remains on the rope at all times, and a split socket or yoke is slipped over the attachment for connecting to the two ends of the safety rope by means of clevises. This method of attaching the safety rope provides a double fastening directly on the main rope.

ing cable is wound. In case of accident to the main rope or hoist, a man, delegated to the duty, releases a spring catch, allowing the dogs to drop. The dogs drop to a point about 2½ in. below bottom of the rail, catching a firm hold on the mine ties and preventing backward run of the trip.

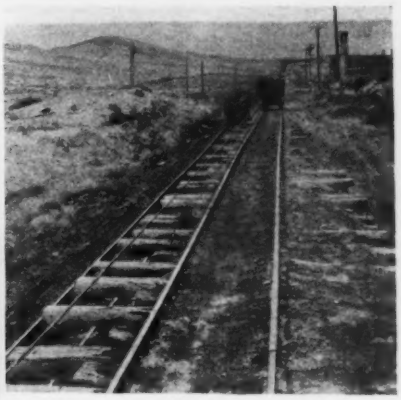
Pumps, Including Main and Gathering, Automatic Stopping Control

Handling of water at the various mines is not a serious problem, as no large flows are encountered. Centrifugal pumps are used at all new major pumping stations, and the sumps are so arranged that the water flows to the pump eliminating the suction lift.

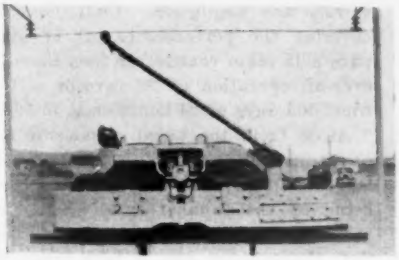
At No. 4 mine, Rock Springs, the largest quantity of water is handled, and this represents the drainage from two mines, No. 4 and No. 8. Two main pumping stations are maintained, and heads are so arranged that duplicate pumps are used. The pumps are 6-stage, 1,725-r. p. m., with a capacity of 500 gallons per minute against a head of 700 ft. At the lower station only one pump is placed, while at the upper or main station two are placed. In case of emergency, one of the upper pumps can readily be moved to the lower station until repairs are made. Each of these pumps is driven by a 200-hp., 2,200-volt motor. One (*Continued on page* 143)



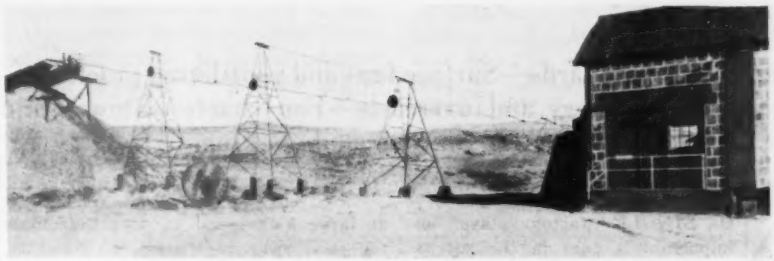
Lower pump room, No. 4 Mine, Hanna



Plane, Reliance, No. 1 Mine



First locomotive purchased by The Union Pacific Coal Company



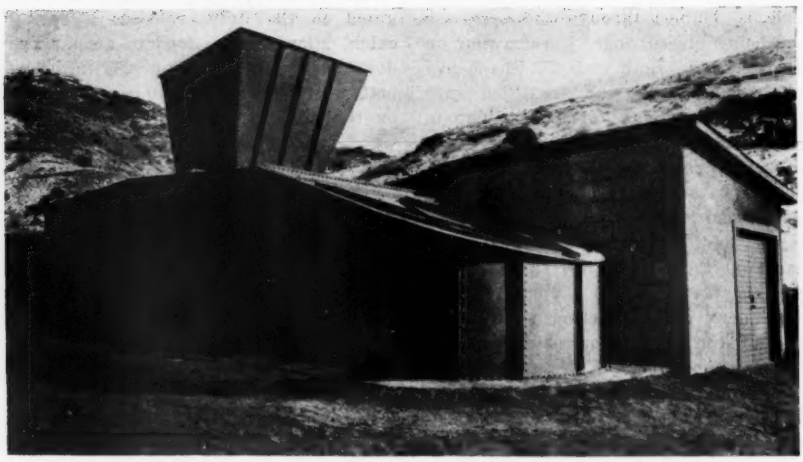
Rope suspension, No. 8 main hoist, Rock Springs

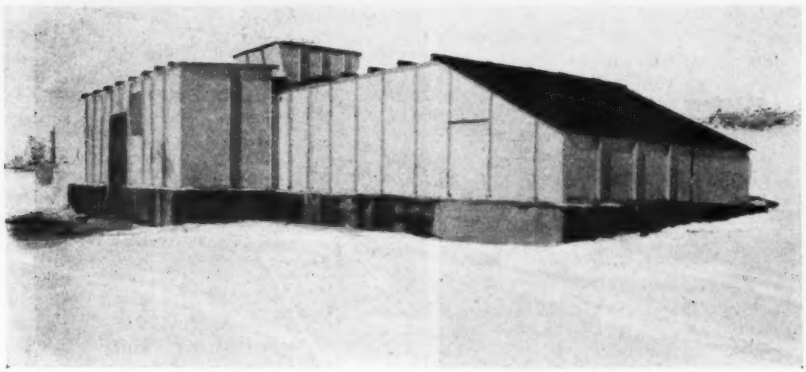
Mantrips

At each of the mines where men have to travel a considerable distance to and from their work, mantrips are used. These consist of specially made cars of a sufficient number so that the men are provided with ample room. Each mantrip is complete with its tool car at the rear end, and all tools must be carried at this point, no one being allowed to take tools on the man cars. At most of the mines the cars are so designed that the men sit back to back on seats parallel to the car, thus allowing them to easily step from the car in case of trouble. The cars are coupled in the regular manner with links and pins, the pins extending

At Reliance No. 1 mine, a safety mantrip equipped with grips is used. These grips are kept in a raised position by their operating rope being attached to the main hoist rope under tension. In case of sudden slack in the main hoist rope, the grips immediately drop, gripping the rail and preventing the trip from running wild.

At Hanna No. 2 mine, a safety mantrip is equipped with short dogs constructed in such manner that the cars can not ride over them when in their lowered position. These dogs, while the trip is being moved, are held in a raised position by the use of a small ratched operated drum upon which their operat-





Upper photograph—Vulcan mine fan installation, "B" Mine, Superior.
Lower—Mine fan installation, No. 8 Mine, Rock Springs

Ventilation standards—Surface fans and ventilating practices—Types of stoppings and overcasts—Fan charts—Blower and tubing for concentrated workings

NO SINGLE factor plays as important a part in the safety of coal mine operation as does mine ventilation. In recognition of this fact, state coal mining laws have been enacted in the several coal-producing states which are intended as a safeguard to the men employed. Most of these laws are based upon tradition, and this is evidenced by the too large number of major disasters occurring in widely scattered localities, many of them being directly or indirectly attributable to poor ventilation, thus it follows that mere fulfillment of the law's requirement does not suffice.

When consideration is given to the cost of the various mine safety programs, devices and appliances within a coal mine, it is certain that no expenditure returns as large a dividend as does that made for good mine ventilation.

As a part of an intensive program instituted by the Union Pacific Coal Company, a code of standards was drafted, including, among other things, rules governing ventilation practices. These rules, of necessity, were not in conflict with state law. Some of the salient features of this code governing ventilation and fan installations are as follows:

First. The fan-housing and air drift shall be of fireproof construction.

Second. All electrically driven fans to be equipped with automatic starters, open-phased relays, pressure-recording gauges, and thermal couples on all fan and fan-motor bearings.

Third. Fan motors to be equipped with sliding base take-up and endless leather belts. In no case is the distance between pulley centers to be less than three times the sum of the diameters of the two pulleys.

Fourth. Motor house to be of ample size to give clearance around moving parts and permit of oiling without stopping the fan.

Fifth. Regulators to be of fireproof construction.

Sixth. Permanent stoppings between main intake and return to be of fireproof construction.

Seventh. Overcast areas on main returns to be not less than the average cross-sectional area of the return.

Eighth. Fans must not be stopped by any person for any cause, except disability to fan or drive, without permission of the superintendent.

All main fans of the Union Pacific Coal Company are electrically driven except those at gaseous mines, these being operated by steam. Several of the electrically driven fans are remotely situated, since they are self-starting, and the bearings are protected by thermal couples, requiring attention but once each week to see that oil levels and the bearings are properly maintained. Power interruptions, except from an occasional storm, are negligible. Chart records covering the performance of the company's 15 main ventilating fans show an over-all operation of 99 percent of the time, 366 days of 24 hours each, in 1928.

Aside from the usual arguments for or against the exhaust fan, this company has committed itself, all of its main fans being of the exhaust type. It is the belief of the company's operating officials that the exhaust fan is best suited to the climatic conditions obtaining in Wyoming. With a temperature range of 130° F., the exhaust fan gives a greater degree of safety to men on haulage. As the laws of Wyoming permit the firing of shots during the working shift (which is common practice under certain regulations in the nongaseous mines of this company), smoke and fumes from these shots would of necessity be passed through main haulage roads with a blower fan. The exhaust fan permits of shooting with a minimum of discomfort to all men within the mine. The quantity of air passed by the various main ventilating fans of the several mines depends upon their size and the extent of their workings. The largest volume passed by any of the company's main fans is that at No. 1 mine, Reli-

* Ventilation Engineer, The Union Pacific Coal Company.

VENTILATION

By HUGH MCLEOD *

ance, which passes 150,000 cu. ft. per minute with a 1.4-in. water gauge.

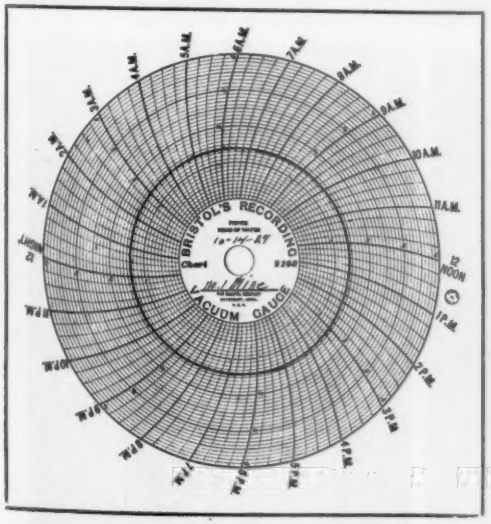
The practice of splitting the air is followed throughout all of the Union Pacific mines, each entry or section being upon a split of its own, wherever possible. Company rules specify that "at each split not less than 65 percent of the air entering any split shall pass through the last crosscut. This amount, 65 percent, to be in excess of the law's requirements." Where roof conditions are such that little or no weight is thrown upon the stoppings, tile is used in their construction. While cost of tile stoppings is less than that of any other type of stopping of fireproof construction, however, it is unsatisfactory where the tile are subjected to roof pressure. Rock and concrete stoppings are used wherever the tile stoppings are inapplicable; however, they are more expensive, but, viewed from all angles, the latter are most satisfactory.

In areas of fire within the mines neither tile, concrete nor rock stoppings are used. As a rule, these fire areas are subjected to considerable roof movement and any stopping so resistant as a masonry wall can not be kept tight at the rib. For this reason, block stoppings laid up in clay and faced with plaster are used exclusively for sealing fires. All of the fire stoppings are equipped with 2-in. pipes with a gate valve in each pipe, the use of a gate valve on these pipes making it possible to insert a thermometer for taking temperatures, also facilitating the taking of samples from behind the seal. These samples are taken at regular intervals and are analyzed with the Orsat testing equipment.

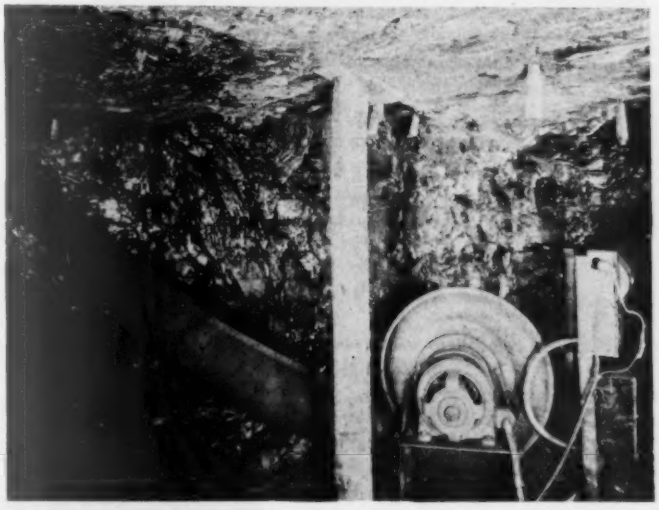
Overcasts are all of fireproof construction using either concrete, tile, or masonry sidewalls, the span of the overcast supported by steel rails, which are cemented in place, using tile for the floor. Easement for the air at overcast is provided by banking the ends. As before stated, the area above overcasts on main returns is equal to the average cross section of the air course. In the construction of overcasts, care is taken to avoid sharp bends in constricted areas as much as possible in an attempt to reduce frictional resistance to a minimum.

One important regulation pertaining to fan charts is, "The fan chart must be changed daily before 7.30 a. m. and it shall be examined by the mine foreman who shall satisfy himself that the fan has been in continuous operation for not less than six hours preceding his examination of the chart, signing his name thereon, prior to permission being given any working force to enter the mine" (Sec. 4435, Mining Laws of Wyoming). "Fan charts shall bear the date of their placement on recording instrument, and breaks in graph, whether showing complete stoppage of fan or changes in water gauge, must be explained in detail on back of charts. The mine foreman will make prompt delivery of fan charts to the mine superintendent, who will examine and thereafter countersign same, forwarding all charts to the general office on the same day they are removed from the recording instrument". This regulation has done much to assure nearly 100 percent operation of mine fans, as all operating officials are thus kept in daily touch with fan operation and are particularly desirous that no stoppage be recorded from avoidable cause.

The loading of coal by mechanical means has brought about a new condition within the mines necessitating changes in many ways. With immobile types of loading equipment, such as the shaking conveyor, it is imperative that shots be fired on the working shift. That this may be done (in nongaseous mines) it is essential that large volumes of air be delivered directly at the working face. To accomplish this (*Continued on page* 143)



Typical fan chart from No. 1 *Mine, Reliance*



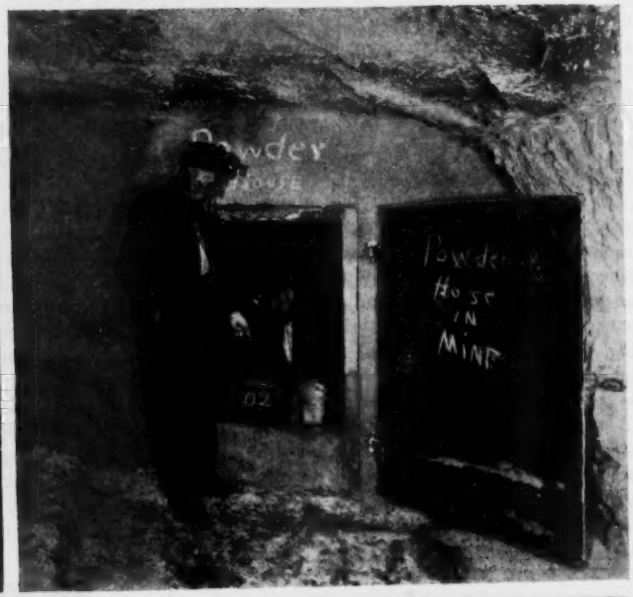
Typical booster fan installation, No. 8 *Mine, Rock Springs. The surrounding canvas has been taken down to obtain the photograph*

HANDLING EXPLOSIVES

Upper, left: Cap man taking caps from cap house to mine

Left: Main storage magazine for permissibles

Below: Powder house inside of mine



Above: Main cap storage magazine

Left, below: Making cartridges of explosive at mine magazine

Right, below: Charging drill holes. Note paper bags filled with clay and wooden tamping bar

at Reliance

By M. W. MEDILL *

Powder magazines and methods of distribution — All permissible explosive with electric firing — Containers and powder cars—Methods of shot firing—Safety precautions followed

THE handling of explosives requires constant care and supervision in order that the maximum efficiency may be obtained and the number of accidents be reduced to a minimum. Blasting of coal in the Reliance mines is done with permissible explosives and electric detonators of No. 6 strength. These permissibles are susceptible to moisture, and if care is not taken in storage their efficiency may be impaired.

All explosives are ordered through the store department. As soon as a carload of permissible is received in the railroad yard it is transferred by wagon to the main magazine, care being taken that the wooden cases are not broken in the handling. The fresh shipment is stacked separately from cases already in storage so that the older supply may become exhausted before any of later date is removed.

The main magazine, situated the required distance from any habitation, has a storage capacity of more than one carload and is of concrete and rock construction with provision for adequate drainage and ventilation. Each day the store department transfers the required amount of explosive from this magazine to the one at the mine.

The permissibles are handled in fiber boxes from the mine magazine to the working face. At the end of each shift the miners leave one of their empty containers in a large box at the mouth of the mine. The next morning these containers are taken from the mine mouth to the mine magazine to be filled.

Before the cartridges are placed in the fiber boxes they are marked individually, by means of a special stamp, with the check number of the miner or loading unit to which they are consigned. The stamps perforate the paper shells and there is little chance that the markings may be erased. If any sticks of explosive should be found amongst the coal in the pit cars, on the screens or chutes at the tipple, or in the railroad cars, it is an easy matter to ascertain the miner or unit crew that was negligent in the handling of the explosive, and steps can then be taken to prevent repetition of the offense.

The filled containers are taken from the mine magazine and placed in a specially constructed powder car, having hinged doors covering the top, and an insulated drawbar. After the day shift has left, the powder car is lowered into the mine with the slope rope, and the containers are stored in the inside powder house until morning.

A man, detailed for the duty, precedes the day shift into the mine. He arranges the containers in numerical order and as the miners pass the powder house they call their check number, and the desired container is passed to them. The miner carries the filled container to his working station where he places it in a covered wooden box, situated in a crosscut or a recess in the rib away from possible haulage accidents or falls of rock or coal.

Before the charges are made up and the drill holes tamped, all power is cut off wires leading into the working place as a safety precaution against premature explosions. The charges consist of not more than 1½ lbs. of permissible explosive with electric detonator having 8-ft. lead wires. In charging the drill holes, it is essential that all sticks of explosive be pushed together to the back of the hole to prevent a parting of coal dust forming between the several cartridges, resulting in unexploded powder being left at the back of the hole when the charge is detonated. After the explosives have been inserted, the balance of the drill hole is tamped to the collar with incombustible material, usually clay, contained in paper bags 1½ in. x 11 in.

During the night shift a certified shot firer visits the working faces, and, after examining the shots, he finds that all holes are tamped to the collar and none are drilled on the solid, he connects the shots singly to a No. 18 rubber-covered cable and detonates the charge with a permissible shot-firing machine of the magneto type.

The electric detonators are handled through the store department in the same manner as the permissible explosives. They are hauled from the railroad car to the main cap magazine, and from there each day's requirements are taken to the mine cap house. A cap man takes a day's supply of detonators from the mine cap house and visits all working places, leaving the desired number of caps with the miner or loading unit crew. If there should be any caps remaining after making the round of the mine he places them in a concrete box provided for cap storage.

SAFETY PRECAUTIONS

Careful handling of explosives during transfer from railroad car to storage magazine.

Storage in a well-drained and ventilated magazine.

Only permissible explosives are used in the blasting operations.

Marking each cartridge with the miner's or unit's check number. This tends to make the workman more careful in the handling of the explosive.

Explosives kept in locked magazines.

Explosives taken into the mine in properly insulated powder cars.

Explosives carried in fiber containers.

A responsible man to issue filled containers and keep an accurate list of all boxes handled.

A responsible man to deliver caps and keep a check of same.

Detonators, with ends twisted together, kept in cardboard containers until needed.

All power cut off wires leading into working places before charging drill holes.

Charges for drill holes kept within the permissible limit.

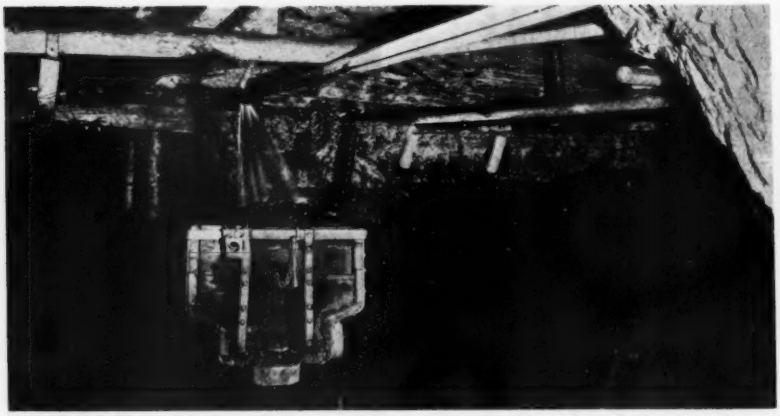
The use of a wooden bar in tamping drill holes. All holes to be stemmed to the collar.

Shots fired by certified shot firers after the day shift has left the mine.

Shots fired with a well-insulated cable and permissible blasting machine.

* Superintendent, Reliance Mines, The Union Pacific Coal Company.

SAFETY



Trip of loaded mine cars receiving spray of water as it leaves the partings on its way to the outside

TO PROCURE the maximum of safety in coal-mining operations of the Union Pacific Coal Company five cardinal principles are recognized, viz:

(1) Adequate and uninterrupted ventilation.

(2) The use of only permissible powders.

(3) Elimination of open lights.

(4) Reduction of coal dust and the prevention of dust dissemination through the workings.

(5) A trained and disciplined personnel constantly cognizant of their individual responsibility.

Of these the last is by far the greatest and most important, and, apparently, the hardest to secure. Merely by money expenditures the first four can be obtained, but expenditures, no matter how great, can not buy the last, unless each and every workman is willing to give his unrestricted cooperation and wholehearted support to the safety movement.

It is probably true that our present civilization has been made possible only by the fact that a few of the more daring ones have always been willing to "take a chance," and, as this characteristic will always be a predominating one, it is unlikely that a point will ever be reached in coal mining where there are no accidents. To bring accidents to an irreducible minimum and the elimination of the avoidable injuries is the aim of this company.

The Union Pacific Coal Company was one of the first coal-producing concerns in the United States to recognize the possibilities of an inert dust as a preventive against explosion propagation and to start practical experimenting along this line.

As early as the summer of 1911, adobe dust was introduced into No. 1 mine, Reliance; it then applied to haulageways and manways, the idea being that the travel by men and animals would keep the dust in suspension to be carried by the ventilating currents and later be deposited on roof, sides, and timbers. Meeting with objections on account of the possible physical effect of the dust upon employes, the experiment was abandoned and no further work was done with rock dust until 1924, when an active program was inaugurated.

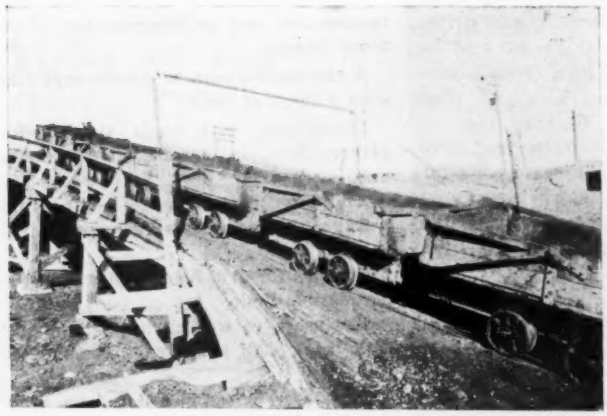
With but little known as to methods, representatives were sent to various companies who at that time had assumed leadership in rock-dusting experiments, and the results of their efforts were brought back and adopted. As a consequence, the Union Pacific Coal Company was among the earliest coal producers in the United States to boast of 100 percent rock-dusted mines.

As it was impossible at that time in this district to purchase a satisfactory material for rock-dusting purposes, the dust was originally manufactured on the property. A fire, two years ago, destroyed the plant, which by then was obsolete and inefficient, so since that time the dust has been purchased from cement plants. An average of 2,500 tons of dust are required annually in the 11 mines of the company.

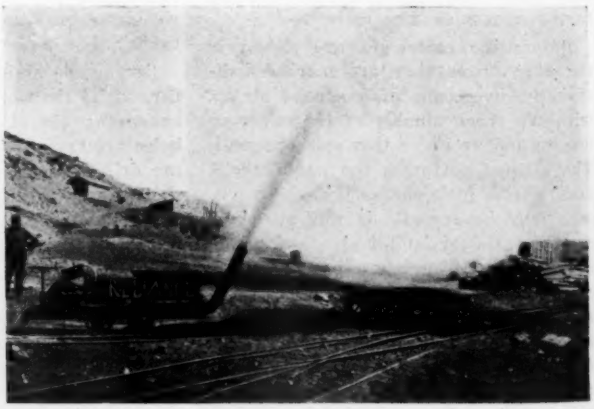
All entries, slopes, haulageways, and portions of the mines which are readily accessible are dusted on roof and ribs. Both machine and hand casting methods are used, the manner of application being largely governed by the physical properties of the places that are to be treated, and, to a lesser extent, by the preference of the local superintendent.

Trackless and remote portions of the

* Safety Engineer, The Union Pacific Coal Company.



Sprinkling pipe and stand used for wetting empty cars before they are taken into the mine. This precaution has proven helpful in the prevention of dust dissemination in the mines



A rock-dusting machine at No. 1 Mine, Reliance, Wyo.

DEPARTMENT

By J. A. SMITH *

Rock dusting and dust barriers—Sprinkling system for loaded trips, haulageways — Atomizers on intake air—Water for machine cutter bar—Closed lights—Mine rescue, fire fighting and first aid training

mines are protected with dust barriers of the V trough, 16 troughs per battery, type which are located at strategic points. In addition to the dusting of the entries, all haulageways are equipped with dust barriers, thus sectionalizing the mine and constituting a secondary defense.

In order that operating officials will at no time feel a false sense of security from the rock dust, at regular intervals dust samples are collected from all mines and analyses are made for incombustible content. These analyses are made with an M-S-A volumeter. Whenever it is shown that parts of the mine are running too high in combustible content, these portions are immediately redusted.

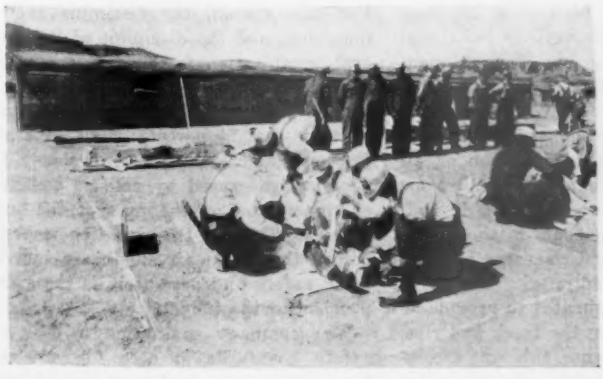
With a view to further elimination of explosion hazard, after much preliminary experimenting black powder was eliminated from all mines of the system, and for the past several years nothing but a powder bearing the permissible stamp is permitted within the mines. As a further precaution, systems have been developed in the handling of powder, both underground and surface, until today it is felt that the possibility of accident from powder and from blasting practices has been reduced to a minimum. This is reflected in the accident record, which shows remarkably few injuries considering the amount of powder used, blasting done, and the varying conditions under which the coal is mined.

A fundamental principle in the battle against coal dust is the allaying of it at its source, thereby preventing its presence in the ventilating currents to be carried and deposited in all portions of the mine. During 1925 and 1926 approximately 60 miles of pipe lines were laid in order that all mines could be adequately equipped with sprinkling systems. This included pipe lines into every working face in order that water could be applied on cutter-bars of mining machines; sprinkling devices for wetting down the tops of loaded cars as they leave the partings and the empty cars as they enter the mine; in certain cases atomizers on intake air; and pipe lines with hose connections for sprinkling haulageways and traveling entries.

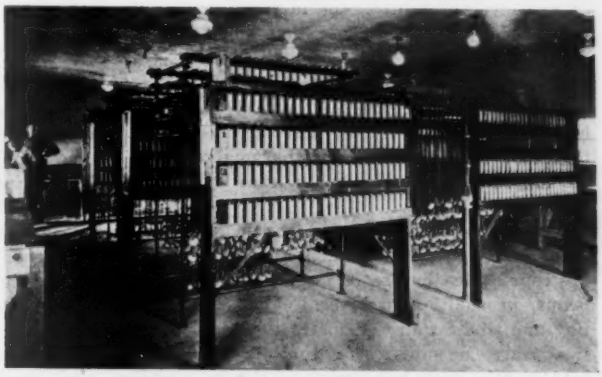
In all mines of the system water on the cutter-bars of mining machines is today considered as indispensable as the electric power, and any employe found violating this rule is subjected to discipline, and, in aggravated cases, to discharge. After machine men have once realized the value of water and have experienced the decreased inconveniences of their tasks, due to the freedom from coal dust in the air they must breathe, no opposition is met in its use, and the men would, under no circumstances, return to the old dry cutting methods. Incidentally, it might be mentioned that the Union Pacific Coal Company was among the first, if not the first, in the United States to use water on cutter-bars of mining machines. It was first used in No. 4 mine at Hanna, Wyo., in 1912, and has been practically in constant use at that place since that date. The use gradually spread to the other mines, and became universal in 1926.

The sprinkling of loaded and empty cars has proven to be another beneficial step in the prevention of dust dissemination. In addition to the wetting of the coal at the face before loading, the tops of the loaded cars receive a spray of water as they leave for the tipple, and again the empty cars are wetted before being returned to the mine. The effect is particularly noticeable on the entry ribs and on the timbers in places where the trip movement is rapid. Here it is found that the dust deposit is greatly reduced and can be readily neutralized by the application of rock dust.

With the exception of the three mines in the Hanna and Cumberland districts, all Union Pacific mines are nongassy.



First aid teams at work during the annual contest at Rock Springs. Thirty-one teams, including Boy and Girl Scout teams, took part in the 1929 competition



Interior of lamp house at Rock Springs. This place has a capacity of 1,000 lamps, each employe receiving his lamp in the morning and returning it at the completion of the shift

Men working at faces of stopes and panels are protected from possible run-away cars by heavy rails, suspended from timbers and resting between the rails

V-trough dust barriers. Sixteen troughs, each containing 300 pounds of shale dust, constitute a battery. These troughs are set in ¾-in. notches and are easily tipped, discharging their contents into the atmosphere, in case of explosion

Nevertheless, all are worked on the same basis as though they were producing gas. All open lights are prohibited, each miner being supplied daily with an approved electric cap lamp. A daily charge covering the cost of charging, repairs, and maintenance is made to each employe for these lamps, no attempt being made by the company to make this charge a source of revenue. While some opposition was met from a few employes when electric cap lamps were installed, it is very doubtful if any would return to the old carbide lamp as the increased illumination, steady light, and the absence of disagreeable odors more than compensate for the increased weight carried.

Much work has been done toward training the employes in first aid. This training has always been voluntary on the part of the men, and to date approximately 70 percent of the men on the pay rolls are holders of first-aid certificates. This training is given under the direction of representatives of the United States Bureau of Mines. At each of the districts first-aid and mine-rescue stations are maintained and selected groups of men are constantly kept in training to cope with any emergency that might arise. All stations are equipped with five sets of self-contained oxygen breathing apparatus, gas masks of the two-hour and half-hour types, first-aid material, and all other equipment that might be immediately necessary in case of disaster.

Annually a first-aid meet is held at Rock Springs, at which time all districts are represented by one or more first-aid teams, in addition to several teams of Boy and Girl Scouts. Prior to the past two years, a mine-rescue contest was held at this time, but, owing to the increased number of participating teams, limited time available, and the scarcity of competent judges, the mine-rescue events have been eliminated and the contest confined to first-aid events. In addition to the laurel wreath of victory, the team winners are awarded individual prizes.

Much stress is placed upon fire and fire-fighting equipment. While the elimination of the fire hazard is considered the fundamental principle, in case of underground fire reliance is placed upon the water lines and hose, rock dust placed at points of possible origin, and abundant fire extinguishers of the soda-acid and tetrachloride types. Underground stables, where the fire hazard is always greatest, in addition to the usual water and extinguishers, are equipped with automatic sprinkling systems. All fire-fighting equipment is tested at least semiannually, and defective parts replaced. At the Reliance mine and Hanna No. 2 mine, large areas have fired, and, as the physical properties preclude the possibility of contact fighting, these areas are sealed. Seals are examined every eight hours and record made of the examination.

Much of the accident-prevention work of the company has been along the lines of elimination of the various individual hazards, in ways too numerous to mention in a short article. Two precautions that have been especially productive in results are the provisions for clearance in the mines and the inspection of all electrical and mechanical installations before they are allowed to be used. Following two fatal accidents in the mines, both due to insufficient clearance between the cars and the entry rib, an active campaign was inaugurated to provide 30 in. clearance between the track and ribs. At considerable expense, this was accomplished, and now, with inflexible rules governing setting of timbers, laying of track, and unloading material within the 30-in. clearance distance, during the past three years there have been no serious accidents attributable to this cause.

Before any mechanical or electrical installation can be operated it must be inspected. When installation is commenced a red "danger" tag is placed upon the controller, indicating that before it can be started that the red tag must be removed. Upon the completion of the work, the chief electrician and the safety engineer must make an inspection, and they are the only ones empowered to remove the red tag. It has been found that, not only for safety but from a standpoint of first-class workmanship, much benefit results. It is only natural that if a workman knows that his work will be inspected and passed upon that he will put forth his best efforts, and the minor details, so often slighted, will receive the necessary attention.

With the exception of the few things that the operator can do toward safety, most of which can be expressed in terms of money expenditures, in the last analysis, the safety movement is an individual affair. Nothing that the operator can purchase can make a man think. For this reason, the discipline of the individual and the discipline of the general organization is the only means by which the accident rate in coal mining can be reduced. Competent authorities estimate that 95 percent of all accidents are avoidable. Of these, probably 90 percent are caused by acts of omission or commission on the part of the ones injured. To bring this situation squarely before the workman and cause him to think safely and act safely is the great problem of the industry.

The company maintains a book of safety standards, printed in loose-leaf form, which is revised from time to time as experience suggests. This book is for the use and guidance of all officials of the operating (*Continued on page* 143)

TIME STUDIES

By R. R. KNILL *

Time studies on mechanized loading—Man-minute and machine-minute bases—Operating divisions of the loading cycle—Charts for different types of studies

THE success or failure of a mechanical loading program depends upon the efficiency of the individual working units and the coordination between them. To obtain this, it is essential to have definite data concerning the capacities of the haulage equipment, tipples, and the loading machines. Getting this information calls for the "time study."

Time studies taken by this company are mostly graphical and are usually taken on a man-minute or a machine-minute basis. At times it becomes necessary to use a combination of the two. Some haulage studies are taken by recording time, work performed, and location in a notebook, but unless this is made into a graph they are not as comprehensive as they should be.

The graph is made in pencil in the field as the work is performed and inked in the office, so that blue prints can be made for the use of the underground management. The different pieces of work done are recorded on the left side of the paper, and usually 10 lines are allowed to show the work for each hour. There is enough room to show one-half shift on each page. The paper is divided into 60 spaces from left to right, and each space represents one minute, so that each section shows one hour of time across the paper.

The taking of time studies is best explained by referring to the graphs. *Figure 1*, which is a study of a 5-BU Joy loader, is taken on a machine-minute basis. Such notes can be taken either upon the graph or a separate piece of paper and as much information as possible concerning the conditions of the working place, haulage, supervision, members of the crew, material, etc., should be recorded. The first section shows the time from 7 to 8 o'clock. The graph starts at 7.30 and shows five spaces or five minutes "starting" which is the time of the shift used by the men to take off coats, get a drink, etc. At 7.35 a vertical line is made from item "starting" to "loading," indicating time loading started. Loading was easy, and the first car was loaded in one minute. There was no delay changing cars and loading continued for one minute longer; the line drops to "picking"; the machine was delayed two minutes while the face was loosened by picking. Loading continued for one-half minute and it was necessary to shift the machine, and so on. The horizontal lines indicate time and the vertical lines a change of work. As each car is loaded a small vertical line is made with a number above it, showing the number of cars loaded thus far. The total for each item during the hour is obtained by adding the spaces across which were used by the graph line. The result of the first half hour's work shows: "Starting," 5 minutes; "loading," 13 minutes; "shifting conveyor," one-half minute; "shifting machine," 4½ minutes; "shifting cars," one-half minute; and "picking," 6½ minutes, making a total of 30 minutes. The hourly totals are added to get the total for each item for the day.

The man-minute study is taken very similarly. *Figure 2* shows a study taken on the man-minute basis. This graph is made of a shaking conveyor working in a scraper pillar. There are four men to the crew; one at the discharge end of the pass and three at the face. This study is made with the time study engineer at the face so that the cars are not noted as loaded, although it is usually possible to do this. The number of cars loaded can be obtained from the man at the discharge end hourly or at the end of the shift. The man-minute study considers the men of the crew and not the machine. The same graph is used as for the other and the time is marked off similarly. The numbers shown on the graph at the vertical lines indicate the number of men performing that particular piece of work. "Loading" on this graph represents the time spent by the car loader at the discharge end and also the time the conveyor is running. The graph starts at 7.30, and five minutes is used "starting"; at 7.35 one man is charged to "drilling" and three to "fixing rollers"; 7.39 two men were "drilling" and two men "fixing rollers," and so forth. To calculate the number of man-minutes, multiply the number of spaces by the figure at the vertical line. Calculating the man-minutes for the first half hour there would be: "Starting," 5 spaces or minutes by 4, making 20 man-minutes; "loading," none; "drilling," 1 times 4, plus 2 times 13, totaling 30; "fixing rollers," 3 times 4, plus 2 times 21, totaling 54; "miscellaneous," 2 times 8, equaling 16. The total for the five items is 120 man-minutes, which is equivalent to four men working 30 minutes each. The total for the day is made from the hourly sections calculated as above.

The four time studies shown were chosen to show the different applications. *Figures 1 and 2* were described above. *Figure 3* is a study of the shaking conveyor on the long face and is machine-minute study except the dotted lines on the graph, which are man-minutes and represent the time spent by extra men to handle rock. *Figure 4* shows the movements of three pit-car loaders and the motorman serving them. The first five lines of each hour shows the loaders, and the second five the motorman, who also snubs some of the cars into the rooms. The lines opposite "Nos. 1, 2, and 3 Loading" represent the time each one was loading. The time spent by each machine waiting on cars is shown on the line "Waiting on cars" by the space from the vertical line dropping from the "loading" line to the vertical line returning to the "loading" line; that is to say, No. 2 machine waited from 8.19 to 8.33. The graph below shows what the haulage man was doing during that period.

The reports on the time studies consist of a blue print of the graph, general dis-

* Mechanical Foreman, The Union Pacific Coal Company.

Fig. 1 Time Study of Joy Loader

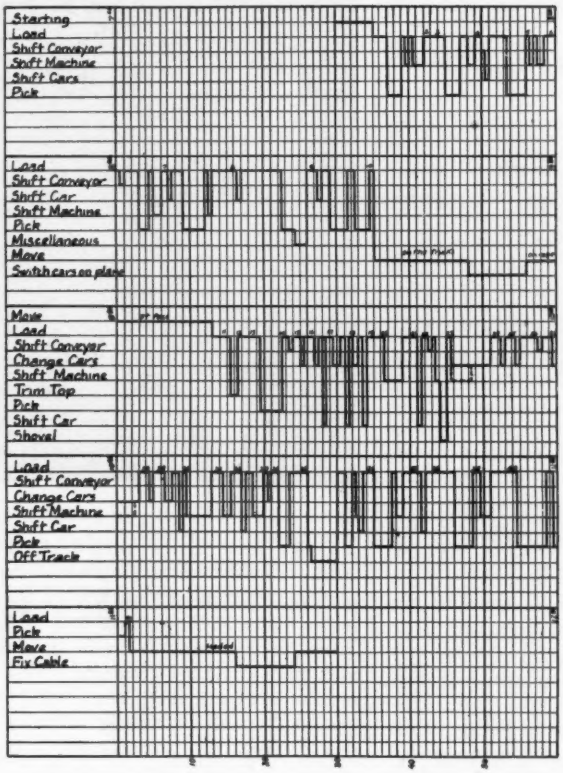


Fig. 2 Man Minute Study of Shaking Conveyor

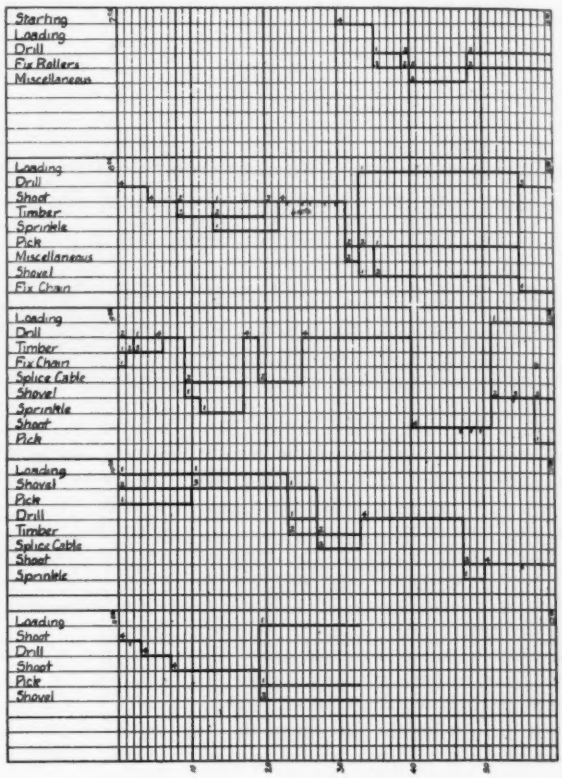


Fig. 3 Time Study of Shaking Conveyor on Long Face

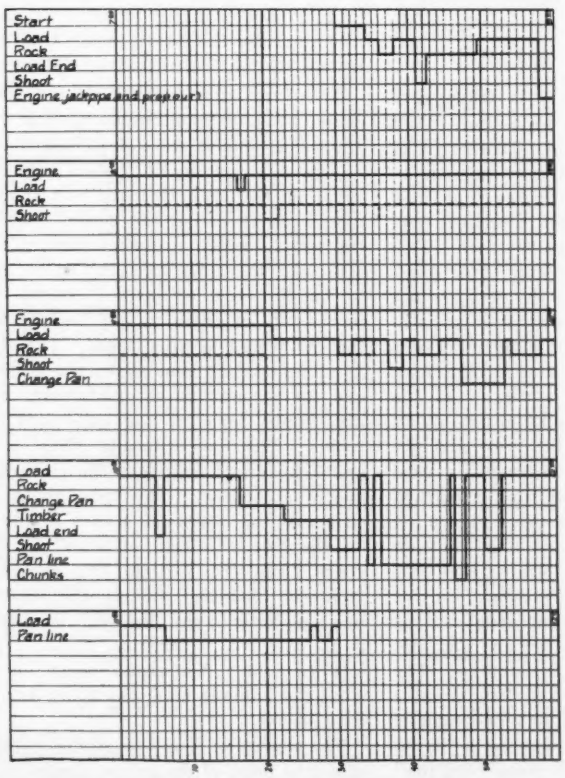
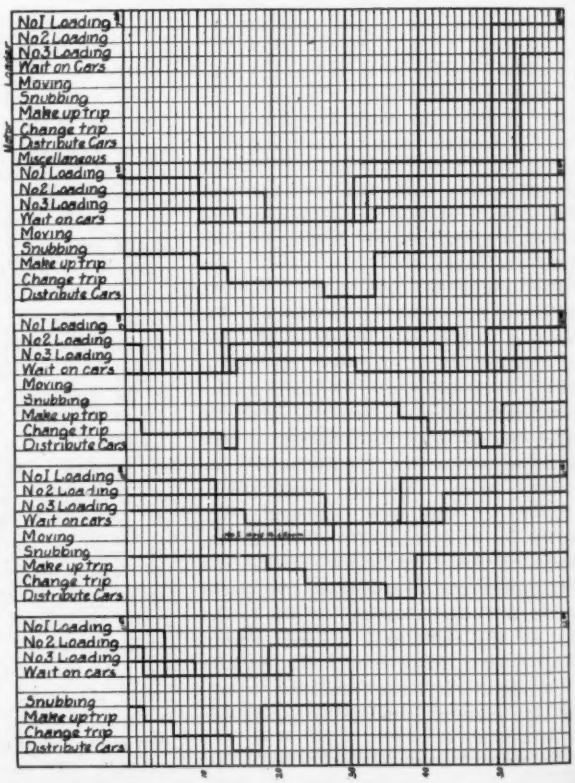


Fig. 4 Time Study of Pit Car Loaders and Haulage Motor



cussion of the day's work when the first study is reported, and a summary similar to the one shown below:

SUMMARY

Item	Machine Minutes	Percen	Remarks.
Start	4	.83	
Loading	202	42.09	182 tons—.90 T/M.
Shooting ...	28½	5.94	3½ min. per shooting period.
Changing Pan	36½	7.60	6.1 min. per pan chg.
Greasing ...	3	.63	
Timber	9½	1.98	
Rock	18	3.75	Not time of extra men.
Pan Line ..	32½	6.78	
Ratchet	2½	.52	
Drill and Tamp	6	1.25	
Miscellaneous	11	2.29	
Dismantle ..	42	8.75	
Loading End	1	.21	
Chunks	1½	.31	
Engine	82	17.07	Came loose during operation.
Total	480	100.00	

From the above summary a number of things may be determined, and when used in conjunction with the graph it is helpful in showing some of the delays.

It is important in taking a time study that things be recorded as they actually happen and as many explanatory notes taken as possible. The number of studies taken depends on the importance of the operation. It is well to take two or more studies to show an average day's run, then eliminate the more pronounced delays and then take another series to observe the results. When a certain unit is apparently not up to production, it is best because of varying conditions to make a separate study and not try to use one taken on another similar unit or one taken on the same unit but made under different conditions.

In conclusion, it is not expected that the "time study" is a "cure-all," but it can be used to get the facts.

SAFETY DEPARTMENT
(*From page 140*)

department. A smaller and more concise set of rules has been published for the use of all mine workmen, every man receiving same required to receipt for and be governed by the instructions contained therein. No set of rules can be so comprehensive as to include all phases of all work so that, in the ultimate, each individual must be his own set of rules and constitute his own safety committee.

MINE VENTILATION
(*From page 135*)

entirely by "breakthroughs" and line brattice is not altogether satisfactory. With all due respect to the practices and traditions of the industry, our experience has been that face ventilation can best be accomplished by the blower fan. In recognition of the additional hazards introduced by the blower fan, the Union Pacific Coal Company has established definite rules governing blower fan installation and operation. *Figures* 1 *and* 2 illustrate the permissible methods of installing blower fans. One of the principal arguments advanced against the use of blower fans is that of recirculation. Installed on the intake side of the air current, (well set back from the return) and being surrounded by a brattice, in our opinion, well insures against this recirculation. To further prevent this happening, a rule of installation provides "that the volume of air passing on the entry upon which blowers are installed shall be not less than two and one-half times of all blowers on the entry." These requirements in connection with the use of blower fans, together with other safety precautions such as, certified shot-firers (who make an examination of places with a flame safety lamp before shooting), rock dusting, water on cutter bars, etc., provides a measure of safety quite comparable to conditions found in other states and localities where blower fans are "taboo".

It is a matter of record that the State of Wyoming leads all other states in the percentage of mechanically loaded coal. In a large measure, this is probably due to the progressiveness, and liberality of state mining laws and state inspection departments, and, in justice to the law and its officers, it might be pertinent to state that neither has been imposed upon and mine ventilation in the State of Wyoming will be found to compare favorably with that of any other state.

MACHINE INSTALLATIONS
(*From page 133*)

pumps at the upper station must run 22 hours daily to handle the water. Vertical triplex plunger pumps are used at the minor stations, and double-acting 6-in. x 6-in. piston-type pumps are used in most sinking operations.

At No. 4 mine, Hanna, two centrifugal pumps have been installed, replacing three large plunger pumps. These centrifugal pumps are duplicates and have a capacity of 450 gallons per minute against a head of 725 ft. One is placed near the bottom of the slope, while the other is at a point midway between top and bottom of slope. New sumps were made and so placed that all water flows to the pump by gravity. The top sump will hold three days' drainage, and when full exerts a pressure of 16 lbs. per sq. in. on the dam or stopping at the pump room. The lower sump will hold five days' drainage, allowing ample time for repair or other shut-downs. Each pump is driven by a 200-hp., 2,200-volt, 1,725-r. p. m. motor, which is protected against overload, low voltage, and open phase. All wires are in conduit, and the pump rooms are fire-proofed with cement stoppings and steel doors.

To improve the load factor on the power plant, these pumps are operated on the afternoon shift. They are started manually just before the end of the day shift, and automatic devices are depended on for stopping. Each pump is provided with two devices for this purpose. A Cutler Hammer pressure regulator is connected to the sump by a ¾-in. pipe, and when the water lowers so that only 12 in. of water covers the suction pipe, this regulator opens the oil switch, stopping the pump. A home-made mercury-operated device was installed to act in case of any failure of the regulator. It was made by forming a U tube from ½-in. pipe with an insulated contact placed in a pipe tee in one leg at the predetermined water level. The leg of U tube containing the contact was left open, while the other was connected to a low point on the sump. The U tube was then partially filled with mercury and pressure turned in to equal the above water level. Enough mercury was then added to just reach the contact. As the sump fills, the mercury is forced up into the open leg of the U tube .438 in. for each foot of water in the sump. When the pump is in operation and the receding water allows the mercury to seek its level it reaches a point where contact between the mercury and the insulated contact is lost, opening the oil switch and stopping the pump. As the pressure regulator is of the self-closing type, it has been equipped locally with a counter which records the number of times it has acted. When an attendant visits the pump room during the day he observes the number on the recorder, and if it did not operate the evening before the electrician's attention is called to it. These pumps operate approximately five hours daily.

FEDERAL TRADE COMMISSION REPORT

The annual report of the Federal Trade Commission, for the fiscal year ended June 30, 1929, has been issued. The report contains rules of practice and procedure, the full text of the Sherman Anti-Trust Law, the Federal Trade Commission Act, the Clayton Law, and the Export Trade Act. It carries a list of the commission's publications, digests of inquiries carried on at the direction of the President and of Congress, reports on such subjects as false and misleading advertising, chain store inquiry, power and gas utilities, export trade, resale price maintenance, and trade practice conferences with 31 industries.

Form 94 — Figure 1.

THE UNION PACIFIC COAL COMPANY

Daily Time Report, _____192___, _____ Mine No. _____

CHECK NO.	HOURS	RATE	AMOUNT	SPECIFY EXACT WORK PERFORMED	Account Number
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
HOURS					
AMOUNT					

Fig. 1

Eleven columns have been provided for Account Numbers

NOTE: Report on back of this sheet changes in Rates, New Names, Deferred and Overtime.

Correct: Checked and entered by:

_____ Foreman

Form 89 - First Sheet — Figure 4.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—MINE OPERATION
ACCOUNT NO. 1

ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
	SUPERINTENDENCE				
1.	Superintendent				
2.	Clerks				
3.	Master Mechanic and Chief Electrician				
4.	Engineering				
	Total Superintendence (Accounts 1 to 4 inc.)				
	MINING				
5.	Pick Mining Tons @				
	" "				
	" "				
6.	Machine Mining Tons @				
	" "				
	" "				
7.	Yardage Yards @				
	" "				
	" "				
	" "				
8.	Loading Ck Coal, Tons				
9.	Shot Firers and Blasters				
10.	Drillers				
11.	Pumpermen				
12.	Dead Work				
13.	Mechanical Loaders (Details shown above)				
14.					
15.					
	Total Mining (Accounts 5 to 15 inc.)				
16.	DEVELOPMENT				
17.	HAULAGE Hoistmen, Rope Riders and Roller men				
18.	" Motormen, Drivers, Partingmen, Sprayers				
19.	" General				
	Total Haulage (Accounts 17 to 19 inc.)				
	HOISTING AND RAILROAD CAR LOADING				
20.	Hoisting and Plane Engineers				
21.	Pushers, Motormen, Trip Riders, and Greasers,				
22.	Tipplemen, Car Droppers, Trimmers, Box Car Loaders, Slate Pickers, Screeners				
23.	Weigh Boss, Dock Boss				
24.					
	Total Hoisting and R.R. Car Loading (Accounts 20 to 24 inc.)				
	VENTILATION				
25.	Doors and Brattice, Stoppings, Kaus				
26.	Overcasts and Undercasts				
27.	Cleaning Air Courses				
28.					
	Total Ventilation (Accounts 25 to 28 inc.)				
29.	TIMBERING				
30.	TRACK LAYING				
31.	DRAINAGE				
32.					
	GENERAL INSIDE				
33.	Mine Foreman and Assistants (Day and Night)				
34.	Gas Watch and Patrol				
35.	Handling Material and Tools				
36.	Brushing, Handling Gob, Squeeze, etc.				
37.	Partings, Grading, Switches, etc.				
38.	Cleaning Roads, Falls, etc.				
39.	Recovering Material				
40.	General				
41.					
42.					
	Total General Inside (Accounts 33 to 42 inc.)				
	GENERAL OUTSIDE				
43.	Outside Foreman				
44.	Watchmen and Janitors				
45.	Yardmen, Teamsters, Laborers				
46.	Bath House Attendant				
47.	New Tools and Equipment				
48.	Blacksmithing and Bit Sharpening				
49.	Electric Cap Lamps				
50.	General				
51.					
52.					
	Total General Outside (Accounts 43 to 52 inc.)				
	TOTALS				

Figure 2.

85 B-LABOR — Figure 3.

THE UNION PACIFIC COAL COMPANY

Distribution of Labor Performed, Other than for Mechanical Loading
Date _____192___ District _____ Mine No. ___

ACCOUNT NUMBERS	1	2	3	4	5	6	7	8
1 TO 35								
36 TO 60	36	37						
61 TO 90	61	62						
155 TO	155	156						
295 TO	295	296						

Fig. 3

Form 146

THE UNION PACIFIC COAL COMPANY
PAY ROLL NAME LIST

Mine _____ Month of _____ 192___

CHECK No.	NAME	OCCUPATION	HOURS PER SHIFT	DATE Per Hours	DATE No. Days of Shift
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					

Approved:

_____ Superintendent

Fig. 4

DAILY COST ACCOUNTING for Coal Mines

By FRANK TALLMIRE *

Classification of principal factors of a coal mining cost sheet—Brief comparison between accounting methods for hand and mechanical loading—Complete forms for all labor and material records and cost statements.

THE economical operation of a coal mine, regardless of the methods used, can be accomplished only by close supervision not only on the part of the superintendent, the foreman and his assistants who come in daily contact with actual performance of the work, but also by the general officers who may be located at considerable distances from the plant, and who, therefore, can exercise only infrequent supervision.

To be intelligent and effective, supervision must be supported by a knowledge of the facts, and such knowledge can be acquired mainly through written records and reports of what is actually taking place, and the results that are being obtained. It is not sufficient that written reports be available only monthly or even weekly; to be valuable they must be compiled and acted upon daily.

Of the 11 active mines of The Union Pacific Coal Company, the hand loading method is still used in two; four have been entirely mechanized, that is, all of the loading is done by machines, while in five, both mechanical and hand loading methods are used. In order that the management, both at the mines and at the general offices, may have up-to-date information, not only of costs but also of other essential items of operations, a system of daily reports has been provided, which is briefly explained and illustrated below:

A classification has been made of the principal factors comprising coal mining costs, the general accounts being:

I. Labor—mine operation.
II. Labor—mine maintenance and repairs.
III. Labor—mine safety work.
IV. Material—mine operation.
V. Material—mine maintenance and repairs.
VI. Material—mine safety work.
VII. Power

These general accounts have been subdivided into several primary accounts covering practically every item of coal mining operations. The charges to these various accounts are distributed, assembled and reported on a daily cost statement, one copy of which is sent to the office of the president, one to the office of vice president and general manager, and one is retained in the office of the mine superintendent. As of the last day of each month, a copy is sent to the accounting department where the information shown thereon is summarized and used in the preparation of general statistical reports. A brief description of the forms and data entering into the preparation of the daily cost statement follows.

LABOR

As labor constitutes the greater part of cost of mining coal, provisions have been made for recording and reporting labor payments in more detail than other cost items. In mines where hand loading method only is followed, time worked by individual employes is reported by the foreman on Form 94, "Daily Time Report" (*Figure 1*). No names appear on this report, employes' "check" or identification numbers having been assigned at the beginning of each pay period and recorded on Form 146, Pay Roll Name List (*Figure 2*). The foreman enters check number, hours, rate and amount; distribution to the appropriate accounts is made by mine office clerks. Charges to various accounts on Form 94, are abstracted on Form 85-B, Distribution of Labor performed, Other Than for Mechanical Loading (*Figure 3*), and from that form transferred to corresponding accounts on the Daily Cost Statement, Form 89 (*Figures 4 to 13, inclusive*).

For labor paid on a tonnage basis, weight of each mine car of coal is inserted as to employes' numbers on Form 93, Weights of Coal Mined (*Figure 14*), by the weighman, and summarized and transferred to accounts 5 and 6 on the Daily Cost Statement (*Figure 4*), by the mine office clerks.

Labor paid for on a yardage basis is entered in Form 80, Report of Yardage (*Figure 15*), by the mine foreman; calculations are made and amounts are transferred to proper account on the Daily Cost Statement (Acct. 7, *Figure 1*), by mine office clerks. Actual measurements are made only once in each pay roll period; estimates are made each day for cost purposes and adjustments to actual figures are made at the end of each period.

Mechanical loading being comparatively new and entailing the expenditure of large sums of money, requires additional observation and intensive analysis in order to obtain the best results. For those reasons, while labor and material costs for mechanical loading have been assigned separate accounts (Nos. 13, 58, 91 and 121) on the Daily Cost Statement, these four accounts have been subdivided to reflect the principal classes of labor and material entering into mechanical loading operations, and a timekeeper has been placed in the mines where mechanical loaders are installed. A special Daily Time Report, Form 94-A (*Figure 16*), has been provided for mines where mechanical loaders are used, which is prepared by the timekeeper, who also cooperates with the

* Auditor, The Union Pacific Coal Company.

Figure 5.

Form 89 - First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

LABOR-MAINTENANCE AND REPAIRS TO ACCESSORIES TO MECHANICAL LOADING (DETAILS OF ACCOUNT NO. 53)

ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
53a	Mining Machines				
b	" " Cables				
c	Electric Drills				
d	" " Cables				
e	Blasting Machines				
f	Signals and Lines				
g	Blower Fans				
h	" " Tubing				
i	General Overhauling of Mechanical Loaders				
j					
k					
	TOTALS				

LABOR-MINE MAINTENANCE AND REPAIRS ACCOUNT NO. II.

ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
53	MAINTENANCE AND REPAIRS OF ACCESSORIES				
54	ELECTRIC PLANTS (Outside)				
55	SUBSTATIONS				
	MINING MACHINES AND DRILLS				
56	Mining Machines and Cables (Other than Accts. 53)				
57	Drills and Cables (" " " 53)				
	Total Mining Machines and Drills (Accts. 56-57)				
58	MECHANICAL LOADERS (Details shown above)				
	HAULAGE EQUIPMENT				
59	Trolley Lines, Feed Lines, and Bonds				
60	Locomotives and Hoists				
61	Pit Cars				
62					
63					
	Total Haulage Equipment (Accts. 59 to 63 inc.)				
	HOISTING AND R.R. CAR LOADING EQUIPMENT				
64	Tipple, Box Car Loader, and Scales				
65	Main Hoist				
66					
	Total Hoisting & R.R. Car Load. Equip. (Acc. 64-66 inc.)				
	VENTILATION				
67	Blower Fans, Inside (Other than Accts. 53)				
68	Ventilation Fan (Outside)				
	Total Ventilation (Accounts 67 & 68)				
69	DRAINAGE				
	BUILDINGS AND STRUCTURES				
70	Dump and Tipple				
71	Shop Buildings, Hoist House, Warehouse, and Fan Houses				
72	Bath House				
73	Office and Other Buildings				
74					
	Total Buildings & Structures (Accts. 70 to 74 inc.)				
	MISCELLANEOUS EQUIPMENT				
75	Telephone, Light, and Signal Lines				
76	Bath House Equipment				
77	Automobiles and Trucks				
78	Equipment made in Company Shops				
79	Miscellaneous				
80					
	Total Miscellaneous Equipment (Accts. 75-80 inc.)				
	TOTALS				

Fig. 5.

Figure 6.

Form 89-First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

LABOR-MINE SAFETY WORK ACCOUNT NO. III.

ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
81	Supervision				
82	Sprinkling				
83	Rock Dusting				
84	Barriers, Gates, Signs, Refuge, Manholes, etc.				
85	Safety Lamps, (Figure)				
86	Apparatus and First Aid				
87	Examinations and Inspections				
88	Sampling Dust & Air				
89					
90	General				
	TOTALS				

MATERIAL-MINE OPERATION ACCOUNT NO. IV.

ACCT.		COST TODAY	COST TO DATE
91	Mech. Loader Operation (Details shown above)		
92	Explosives (Other than above)		
93	Timber, Props, Bars, Chocks (" " ")		
94	Bratttice Materials, Stoppings (" " ")		
95	Lubricants, Packing, Waste, etc. (" " ")		
96	Feed and Care of Stock		
97	Sand, Sprags, Gasoline for Locomotives.		
98	Rails		
99	Ties		
100	Switches, Plates, Frogs, Rollers, etc.		
101	Haulage Ropes, Shod, Hooks (other than Mech. Loaders)		
102	Tile, Sand, Cement, Overcoats, etc.		
103	Drainage		
104	Blacksmith Supplies		
105	Machine Shop Supplies		
106	Electric " "		
107	Mine Tools and Equipment		
108	Lamps, Lights, Signal, and Tel. Lines.		
109	Office Supplies		
110	Water		
111	Coal, Water, and other materials for the Bath House		
112	Fuel		
113	Mine Fires, Floods, Disasters, etc.		
114	Hand Tools, Shovels, Picks, Drills, etc.		
115	Electric Cap Lamps		
116			
117	General		
118			
119			
	TOTALS		

Fig. 6.

Figure 7.

Form 89-First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

MATERIAL—MAINTENANCE AND REPAIRS TO ACCESSORIES TO MECHANICAL LOADING (DETAILS OF ACCOUNT NO. 120)

ACCT.		COST TODAY	COST TO DATE
120a	Mining Machines		
b	" " Cables		
c	Electric Drills		
d	" " Cables		
e	Blasting Machines, Signal Lines, etc.		
f	Blower Fans and Tubing		
g	General Overhauling of Mechanical Loaders		
h			
i			
j			
	TOTALS		

MATERIAL—MINE MAINTENANCE AND REPAIRS ACCOUNT NO. V

ACCT.		COST TODAY	COST TO DATE
120	Maintenance and Repairs of Accessories (Account 53a-j)		
121	Mechanical Loaders (Details shown above)		
122	Mining Machines and Cables (other than Account 120)		
123	Blower Fans and Tubing (" " " 120)		
124	Drills and Cables (" " " 120)		
125	Cables, M. Mach., Drill, etc. (" " " 120)		
126	Power, Feed, Trolley Lines, Bonds		
127	Electric Plant (Outside)		
128	Substations		
129	Locomotives and Inside Hoists		
130	Hoists (Outside)		
131	Pit Cars		
132	Tipple, Loading Equipment, Scales, etc.		
133	Mine Fans (Main Air Course)		
134	Drainage		
135	Dump and Tipple		
136	Shop Bldgs., Hoist House, Warehouse, and Fan Houses		
137	Bath House and Equipment		
138	Office and Other Buildings		
139	Light, Signal, and Telephone Lines		
140	Shop Equipment		
141	Automobiles and Trucks		
142	Wagons, Harness, etc.		
143			
144	General		
	TOTALS		

Fig. 7.

price, amount, and account chargeable are inserted on Form 79, amounts abstracted on Form 85-A for mechanical loading mines, and on Form 85-C, Distribution of Material Used, Other Than for Mechanical Loading (*Figure 19*), for hand loading mines, and transferred to corresponding accounts and sub-divisions on the Daily Cost Statement.

Power

Electrical energy consumed in the operations of The Union Pacific Coal Company is obtained from the company's own plants. A meter is installed at each mine and charges for power are made on

mine foreman, unit foreman and others in making time studies and preparing data on each loading unit. Charges on Form 94-A are abstracted on Form 85-A, Distribution of Labor and Material to Mechanical Loading Units (*Figure 17*), and transferred to corresponding accounts and subdivisions thereof on the Daily Cost Statement by mine office clerks.

Material

Material is issued from the storeroom, warehouse or storage yard only on approved requisitions, Form 79, Requisition for Material (*Figure 18*). The

Form 89 - First Sheet Figure 9.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—OPERATION MECHANICAL LOADERS
(DETAILS ACCOUNT 13)

LINE NO.	LOADING UNIT NO.	LOADING UNIT TYPE	MEN NO.	HOURS TOTAL	CUTTING HRS.	CUTTING AMOUNT	DRILLING HRS.	DRILLING AMOUNT	BLASTING HRS.	BLASTING AMOUNT	LOADING HRS.	LOADING AMOUNT	TIMBERING HRS.	TIMBERING AMOUNT	MOVING and INST. HRS.	MOVING and INST. AMOUNT	HANDLING ROCK HRS.	HANDLING ROCK AMOUNT	TODAY HRS.	TODAY AMOUNT	TO DATE HRS.	TO DATE AMOUNT
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						
16																						
17																						
18																						
19																						
20																						
21																						
22																						
23																						
24																						
25																						
26																						
27																						
28																						
29																						
30																						
TODAY																						
TO DATE																						
COST PER TON																						
PERCENT TOTAL																						

NOTE: Items

Fig. 9

Form 89-First Sheet Figure 10.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—MAINTENANCE MECHANICAL LOADERS
(DETAILS ACCOUNT 58)

LINE NO.	MEN NO.	HOURS TOTAL	MECHANICAL HRS.	MECHANICAL AMOUNT	ELECTRICAL HRS.	ELECTRICAL AMOUNT			TODAY HRS.	TODAY AMOUNT	TO DATE HRS.	TO DATE AMOUNT
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
TOTALS												

Fig. 10

Form 89-First Sheet Figure 8.

SUPERINTENDENT'S DAILY COST STATEMENT

MATERIALS—MINE SAFETY WORK
ACCOUNT NO. VI

ACCT.		COST TODAY	COST TO DATE
141	Rock Dust		
146	Sprinkling Lines, Fittings, Hose, etc.		
147	Barricades, Gates, Signs, Refuge Places		
148	Safety Lamps (Flame)		
149	Apparatus and First Aid		
150	Fire Extinguishers, Hose, etc.		
151			
152			
153			
	TOTALS		

Fig. 8

PROPORTION OF COST OF POWER
ACCOUNT NO. VII

ACCT.		COST TODAY	COST TO DATE
401	Power		
	TOTALS		

SUMMARY OF PRODUCTION COST

	TODAY	TO DATE	PREVIOUS MONTH
Labor: Mine Operation Acct. V			
" " Maintenance and Repair Acct. IX			
" " Safety Work Acct. III			
Total Mine Labor			
Material: Mine Operation Acct. XI			
" : Maint. & Repair Acct. X			
" " Safety Work Acct. VI			
Total Mine Material			
Power Acct: XII			
TOTAL COST			
Labor: Operation per M.R. Ton			
" : Maint. & Repair per M.R. Ton			
" : Safety per M.R. Ton			
Total Labor per M.R. Ton			
Material: Operation per M.R. Ton			
" : Maint. & Repair per M.R. Ton			
" : Safety per M.R. Ton			
Total Material per M.R. Ton			
Power per M.R. Ton			
TOTAL MINE COST			
MECH. LOADER COST PER TON ALL UNITS			
RATIO LOADER COST TO TOTAL			

Form 93 Figure 14.

Weights of Coal Mined at _____ Mine No. _____

The _____ day of _____ 192__.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Fig. 14

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69

Columns have been provided for 200 check numbers

101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119

Figure 11.

Form 89-First Sheet

SUPERINTENDENT'S DAILY COST STATEMENT

MATERIAL — OPERATION MECHANICAL LOADERS
(DETAILS ACCOUNT 91)

LINE NO.	EXPLOSIVES	TIMBER	RENTS, TIRES	POWER CABLES, LINES	LUBRICANTS	MECHANICAL	ELECTRICAL		TODAY	TO DATE
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

Fig. 11

MATERIAL — MAINTENANCE
MECHANICAL LOADERS
(DETAILS ACCOUNT 124)

MECHANICAL	ELECTRICAL		TO DAY	TO DATE

Figure 13.

Form 89-First Sheet

SUPERINTENDENT'S DAILY COST STATEMENT

MEMORANDUM OF UNUSUAL EXPENDITURES

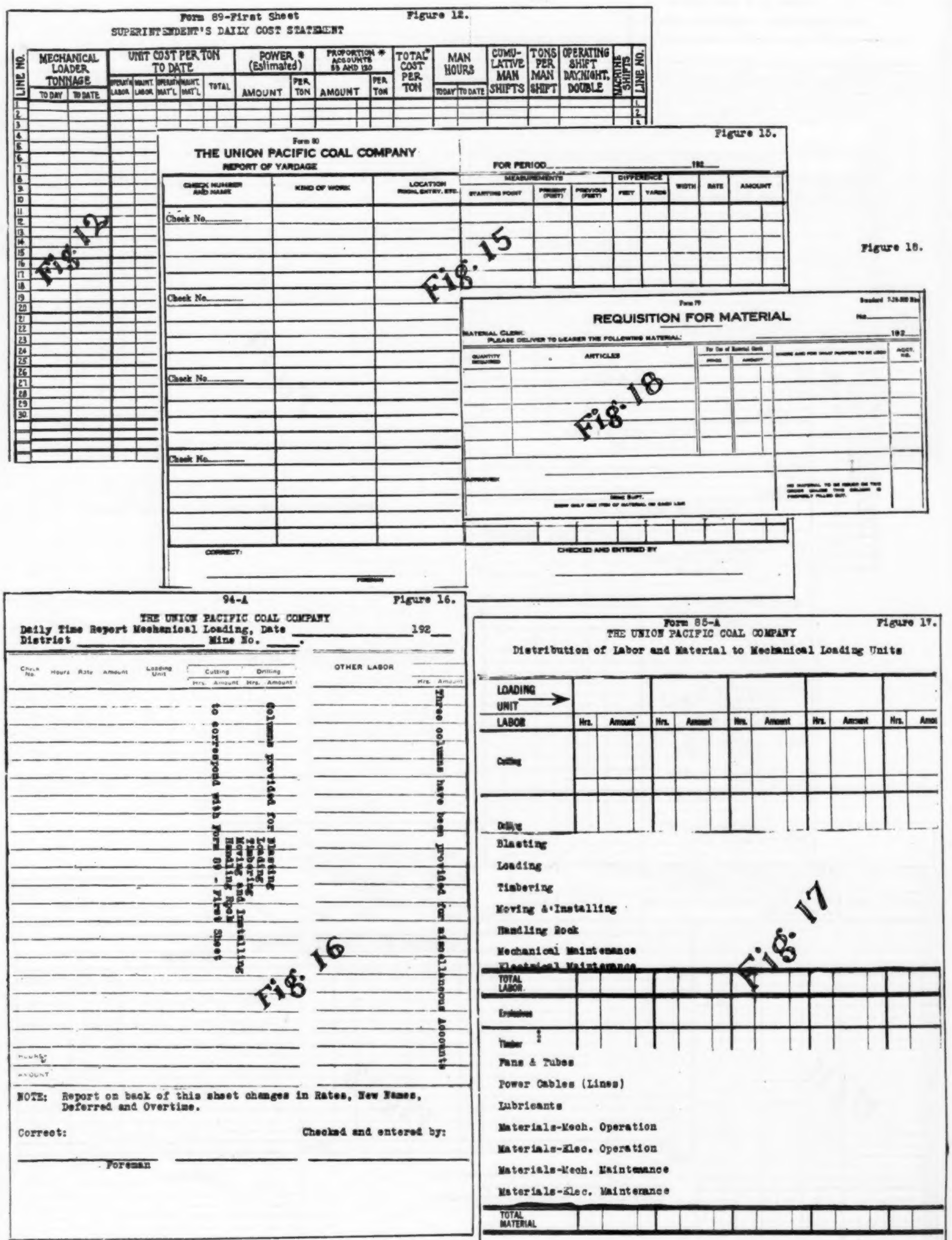
LABOR ACCT.	MEN	HRS.	COST TODAY	COST TO DATE	MATERIAL ACCT.	COST TODAY	COST TO DATE
TOTALS					TOTALS		

Fig. 13

NOTE:

Explain the nature and necessity of unusual expenditures, showing the numbers of the accounts charged. Carry cumulatively for the month and explain in detail on report for the last day of month.

—REMARKS—


Form 89-First Sheet
Figure 12.
SUPERINTENDENT'S DAILY COST STATEMENT
LINE NO.
MECHANICAL LOADER TONNAGE
TO DAY
TO DATE
UNIT COST PER TON TO DATE
TOTAL
POWER (Estimated)
AMOUNT
PER TON
PROPORTION ACCOUNTS 85 AND 130
TOTAL COST PER TON
MAN HOURS
TODAY
TO DATE
CUMULATIVE MAN SHIFTS
TONS PER MAN SHIFT
OPERATING SHIFT DAY, NIGHT, DOUBLE
MACHINE SHIFTS
Fig. 12
Form 80
Figure 15.
THE UNION PACIFIC COAL COMPANY
REPORT OF YARDAGE
FOR PERIOD
192
CHECK NUMBER AND NAME
KIND OF WORK
LOCATION
MEASUREMENTS
DIFFERENCE
WIDTH
RATE
AMOUNT
Check No.
CORRECT:
FOREMAN
CHECKED AND ENTERED BY
Fig. 15
Figure 18.
Form 79
REQUISITION FOR MATERIAL
No.
192
MATERIAL CLERK:
PLEASE DELIVER TO LEASER THE FOLLOWING MATERIAL:
QUANTITY REQUIRED
ARTICLES
ACCT. NO.
APPROVED:
MINE SUPT.
Fig. 18
94-A
Figure 16.
THE UNION PACIFIC COAL COMPANY
Daily Time Report Mechanical Loading, Date 192
District Mine No.
Check No.
Hours
Rate
Amount
Loading Unit
Cutting
Drilling
Hrs.
Amount
OTHER LABOR
Columns provided for Blasting Loading Timbering Moving and Installing Handling Rock to correspond with Form 89 - First Sheet
Three columns have been provided for miscellaneous Accounts
HOURS
AMOUNT
NOTE: Report on back of this sheet changes in Rates, New Names, Deferred and Overtime.
Correct:
Foreman
Checked and entered by:
Fig. 16
Form 85-A
Figure 17.
THE UNION PACIFIC COAL COMPANY
Distribution of Labor and Material to Mechanical Loading Units
LOADING UNIT
LABOR
Hrs.
Amount
Cutting
Drilling
Blasting
Loading
Timbering
Moving & Installing
Handling Rock
Mechanical Maintenance
Electrical Maintenance
TOTAL LABOR
Explosives
Timber
Fans & Tubes
Power Cables (Lines)
Lubricants
Materials-Mech. Operation
Materials-Elec. Operation
Materials-Mech. Maintenance
Materials-Elec. Maintenance
TOTAL MATERIAL
Fig. 17

Form 85-C-Material Figure 19.

THE UNION PACIFIC COAL COMPANY

Distribution of Material Used, Other Than for Mechanical Loading.

ACCOUNT NUMBERS	91	92	93	94	95	96	97	98
91 TO 117								
	118	119	120 a					
118 TO 135								
	136	137	138					
136 TO 162								
	163	164	165					
163 TO								
	298	299	300					
298 TO								

Fig. 19

Form 89-Second Sheet Figure 20.

SUPERINTENDENT'S DAILY COST STATEMENT

ACCT. No.	POWER PLANT	No. DAYS	HOURS WORKED	LABOR COST TODAY	LABOR COST TO DATE	LABOR COST TO DATE PREVIOUS MONTH	MATERIAL COST TODAY	MATERIAL COST TO DATE	MATERIAL COST TO DATE PREVIOUS MONTH
	SUPERINTENDENCE								
102	Proportion of Superintendence								
	PRODUCTION								
167	Turbine Room Operation								
168	Boiler Foreman								
169	Boiler Firemen								
170	Coal to Boilers								
171	Cleaning Boilers								
172	Ash Handling								
173	Water								
174	Lubricants and Waste								
175	Tools and Appliances								
176	Power from General Plant								
177	Purchased Power								
178	General								
	MAINTENANCE AND REPAIRS								
180	Buildings								
181	Pipe and Steam Lines								
182	Electric Lines								
183	Ash Disposal System								
184	Boilers and Superheaters								
185	Stokers								
186	Coal Conveyor								
187	Pumps								
188	Fans								
189	Cooling Pond and Tower								
190	Turbines								
191	Engines								
192	Generators								
193	Exciters								
194	Condensers								
195	Switchboards								
196	Transformers and Arresters								
197	Transmission Lines—General								
	Transmission Lines—Tenements								
198	General								
199	Depreciation								
200	Insurance								
201	Property Retired								
	Total								
	DISTRIBUTION K. W. H.								
	Generated								
	Cost per K.W.H.								
	Reliance Mines								
	Winton Mines								
	Superior Mines								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Water Plant								
	Shale Dust Plant								
	Real Estate Dept.								
	Merchandise Dept.								
	General Office								
	Company Employes								
	Other Uses								
	Total								

Fig. 20

Figure 21.

ACCT. No.	WATER PLANT	No. MEN	HOURS WORKED	LABOR COST TODAY	LABOR COST TO DATE	LABOR COST TO DATE PREVIOUS MONTH	MATERIAL COST TODAY	MATERIAL COST TO DATE	MATERIAL COST TO DATE PREVIOUS MONTH
	SUPERINTENDENCE								
214	Proportion of Superintendence								
	OPERATION								
216	Pumpmen								
217	Delivering Water								
218	Purchased Water								
219	Proportion of Power								
220	Coal								
	MAINTENANCE AND REPAIRS								
222	Pipe Lines and Hydrants								
223	Reservoirs and Tanks								
224	Pumps								
225	Electric Equipment								
226	Buildings and Structures								
227	Depreciation								
228	Insurance								
	Total								
	DISTRIBUTION								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Power Plant								
	Merchandise Dept.								
	Real Estate Dept.								
	Company Employes								
	Other Uses								
	Total								

Fig. 21

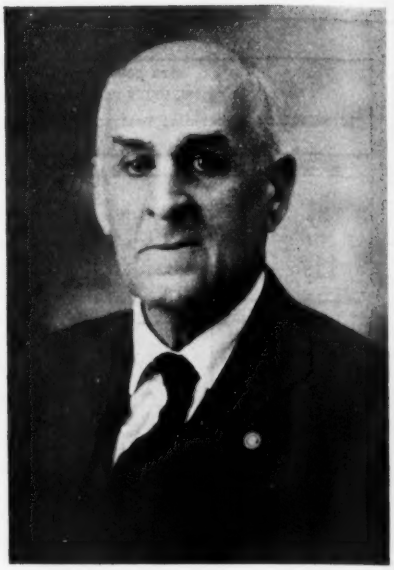
a kw. h. basis. Details of the cost of operating the plant by which the cost of producing power is determined, are reported daily on the second sheet of the Daily Cost Statement (*Figure 20*), and the proportion chargeable to cost of mining is carried to General Account VII, on the first sheet.

At Rock Springs, Wyo., the company owns and operates a pumping plant which is used as an adjunct to the power plant only, water for domestic purposes being obtained from an outside company. At Hanna and Reliance, Wyo., water for all purposes is purchased from outside companies. At Winton, Superior and Cumberland, Wyo., the company owns and operates water plants which supply water for mining operations and other purposes. Where the company owns and operates pumping plants and distribution systems, the expenses of operating them are classified and reported daily on the second sheet of the Daily Cost Statement (*Figure 21*), the proportion chargeable to cost of production of coal being carried to the first sheet. Account 110 (*Figure 6*).

Expenses of other operations not entering directly into the cost of mining, such as dwelling houses for employes, amusement halls, community buildings, hospital and medical services, prospecting, new construction, etc., are also reported on the second sheet of the Daily Cost Statement.

Briefly then the cost of all mining operations of this company have been finely classified and reported daily to both the local and general managements, figures for "today" and cumulative figures from first of month to date being shown. It is necessary to estimate certain charges; in such cases, however, adjustments to actual figures are made at the end of the month. To some operators, even those who are quick to adopt modern machinery and mining methods, an extensive classification and daily reporting of costs may seem like undue refinement and an unnecessary mass of statistics. Other operators, however, recognize the value of up-to-date facts, and will not wait until several days after the end of the month for statistics regarding the conduct of the business for which they are responsible.

MATERIAL DEPARTMENT



By W. K. LEE *

Methods for requisitioning purchasing and distributing equipment and supplies—Card records

THE purpose of the Material Department is to provide material needed, and to properly, promptly and economically care for, handle and account for all such material. The Material Department is in charge of the purchasing agent, and a material clerk is stationed at each one of the six properties.

The heads of the different departments designate the material desired in a "Want Book" located in the material room or store house. From this "Want Book," the material clerk enters the items on a requisition. This requisition, in addition to describing the items and showing the quantity desired, designates the quantity of such items used the preceding month, quantity on hand, the purpose for which intended, and the approximate unit cost of same. The requisition then goes to the mine superintendent for signature, after which it is forwarded to the general offices where it is carefully scrutinized by the various officials, approved and then sent to the purchasing agent.

In the Purchasing Department, the requisition is registered and numbered, and the material clerk from whom it originally emanated is advised of the number on a special form. Formal orders are then made up covering the purchase of the different items, showing, in addition to the order number, the requisition number, and instructing the shipper to quote both numbers on their invoice and to be marked or tagged to the material shipped. A copy of the order is forwarded to the material clerk.

All shippers are instructed to mail their invoices in triplicate and forward same to the purchasing agent and not to the point to which the material is shipped. Upon receipt of the invoices in the Purchasing Department, they are numbered, and the original and duplicate are forwarded to the material clerk receiving the material and the triplicate is retained by the purchasing agent. Upon receipt of the material in good order, the material clerk approves the invoices and forwards the original to the Accounting Department where a voucher in payment is drawn and forwarded to the shipper. In cases where a cash discount is allowed for payment of an invoice within a limited time, the original is forwarded direct to the Accounting Department by the purchasing agent for immediate payment.

A card record is kept of all material received, a separate card being on file for each item. In addition to showing the purchasing agent's number of the invoice and the order and requisition numbers, an entry is also made on the card whenever any of the material is issued, so that by referring to the card the material clerk knows the quantity of any given item he has in stock. The entries of material issued are made on the card from a special form rendered by the heads of the different departments and given to the material clerk in exchange for the material they receive from him.

The material clerk submits a list once every month showing all surplus or slow-moving material that he may have on hand. A copy of this list is forwarded to each of the other material clerks, with instructions to order therefrom whenever possible. A copy is also retained by the purchasing agent, so that he may move some of the surplus material to other mines whenever possible.

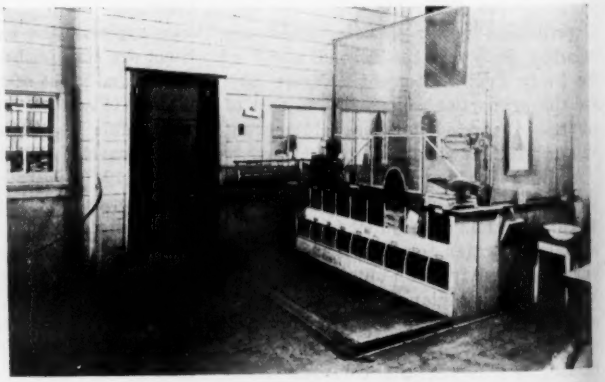
All material is inventoried once each year. However, several check inventories are taken between the general inventories.

All requisitions covering stationery purchases are handled in the same manner as those covering material, except that they are all made by one material clerk and the stationery is all kept at one point, the other material clerks getting their requirements from this stock.

A separate card record is kept of all items designated as "equipment"; that is, motors, pumps, hoists, drills, mining machines, lathes, fans, etc. This card gives a complete description of the item, including serial number, date and from whom purchased, order and requisition number and purchasing agent's invoice number, and (*Continued on page* 158)

* Purchasing Agent, The Union Pacific Coal Company.

Portion of general material room where stationery and mine supplies are stored



Disbursing counter in general material room at Rock Springs

The Trend Toward Better Living Conditions for Employees

By GEO. B. PRYDE *

Early conditions—First attempt toward improvements—Mining towns are now modernized and employes enjoy same advantages as in large communities—Views of towns, dwellings and gardens

IN THE early days of coal mining in southern Wyoming where mines were opened by the Coal Department of Union Pacific Railway Company, later known as The Union Pacific Coal Company, the employes were composed largely of British immigrants. These men had learned the art of coal mining in their native land, and, being of an adventurous spirit, they sought to better themselves in the great West, which was then being opened by the extension of the Union Pacific Railway westward.

Coming from a beautiful country where verdure of every kind was abundant, it was a rude awakening for them and their families to be set down in the desert country of southern Wyoming. The result was they became dissatisfied on account of homesickness, and their entire efforts were predicated on wresting a competence from the new land, then returning to their native heath—"to God's country."

Such a state of mind was not conducive to any permanent plans of living, either temporal or spiritual. The result was that none planned beyond their immediate personal needs and living conditions were of the most primitive kind. Falling in with this attitude, the employing company which originally entered the field, as well as those who came later (although all should have known better), fell into the same habit of insecurity, that here indeed "they had no abiding city." And so mines were opened up in a rather antiquated manner from the abundant coal outcropping on the hillsides.

The early coal mining towns consisted of an aggregation of shacks with two and three room tenements. These were often unpainted and little thought was given to planning any improvements thereon, being bleak and barren at their best, and so the mining towns presented a rather depressing picture. It was generally accepted by employer and employe alike that the climate was such that it would not permit of any successful attempt to improve on nature by planting trees, or the growing of vegetables, grass or flowers.

As the West settled, labor shortages developed with considerable frequency, and as the early employes had come to regard Wyoming as a not altogether bad place to live, our company was compelled to give consideration to the improvement of living conditions by providing better housing facilities, and giving more thought to making the mining town more attractive. While not an innovation, prizes were offered for the best gardens. This was quite an uphill job at first, as the old idea still persisted that southern Wyoming with its short-growing season and climate was not adapted to cultivation of the soil.

Eventually, a few pioneers showed what could be done with a liberal amount of hard work and optimism. Others became encouraged and fell in line and some wonderfully beautiful gardens have been developed. The building of fences has greatly assisted this effort, as people in a mining community like to have their yards properly enclosed as a measure of privacy and to protect the gardens from marauding bands of live stock. The photographs show what can be done in southern Wyoming. True it takes a great deal of hard work plus lots of faith, but the results speak for themselves.

During the last four years a persistent and extensive program of painting our houses has been undertaken. A number of standard colors were adopted, with much more pleasing results than the painting of all houses a stereotyped color. Many of our employes came from countries where the brighter colors in dress predominate and so the variegated painting appeals to them. All roofs are

* Vice President, The Union Pacific Coal Company.

Lawn and flower garden, Cumberland, Wyo.

Employe's garden, Reliance, Wyo.

Type of modern houses at Rock Springs

Houses at Winton, recently modernized

painted green, first as a protection to the shingles, and second as a contrast to the bareness of the scenery contiguous to our mining towns. All painting has been done by the air brush method, as many as four units being in operation at the respective towns during the summer months. This has been found to be an extremely rapid and economical method of doing the work. During the four-year period we have expended annually for this painting almost $15,000.

The building of bath houses in all of our mining towns has proved a wonderful convenience for the employes. Several of the bath houses have been equipped with bathing facilities for women and children. Wherever adopted, this system has worked out quite successfully. A start has been made toward modernizing tenements, and this work will be continued, there being a growing demand among our employes for houses modernly equipped. Concrete sidewalks have been a great convenience to our employes, particularly during stormy weather. This work has had a good start and will be continued until all of the principal streets in our mining towns have been so provided.

An experiment tried during the period of slack work last summer was so successful that it is planned to continue it during the summer of 1930. The common practice is to lay the mines idle for short periods each week to conform to the lessened summer demand for coal. We had figured that it would be a convenience to our employes if they could have an extended vacation of 10 to 14 days, instead of periodical short vacations with a large amount of absenteeism. The system worked out very well and our employes had an opportunity to be away with no loss of earnings, as, during the period of two months in which vacations were allowed, the working time of each district was equalized. It developed in some cases that a two-weeks' vacation was somewhat long, probably a 10-day period would be more satisfactory.

In a Rock Springs garden

Our mining communities, in common with all other parts of the country, have benefited immeasurably from inventions that have been developed: (1) electrical appliances have made lighter the work of the housewife, particularly has it banished the spectre of the weekly wash day by the introduction of the electric washer and iron. (2) The movie has brought the far places of the earth close to home, the recent adaptation of the "Talkie" has made it possible to hear good plays and the best of music. (3) The radio has brought mining communities in contact with many remote parts of our own and other countries until the world seems a small place after all. During the long winter evenings, in this manner, many of our employes are kept in close touch with literature, music, art, politics, religion and many other subjects, and, the many improvements yet to be made in radio, will add greatly to this form of entertainment. (4) The auto, no doubt, has been the one great means whereby the horizon of the average mining community has been enlarged. It has provided a convenient and rapid method of transportation between communities, between towns and between states. During the summer months, particularly, it allows many families to spend much time in the open air.

And so, the combination of what has been done to improve the conditions in our mining communities, together with the advantages of new inventions, is rapidly changing the old mining towns into places with pleasant and agreeable surroundings.

House at Superior and garden at Hanna, Wyo.

COMMUNITY ORGANIZATIONS in the Towns of The Union Pacific Coal Co.

By JESSE MCDIARMID *

Aims and activities of various social organizations—Boy and Girl Scouts—Old Timers Association—Sunday school—Bands and other recreational activities

COMMUNITY organization rather than any form of institutionalism might perhaps express the policy of The Union Pacific Coal Company in relation to the "social activities" that are projected in its towns. We recognize that not only must the level of community participation be reached in making plans as well as in "activity"; but that the success of a project depends on whether or not independence, resourcefulness, initiative and the capacity for cooperation are encouraged in the working group and in the individual members of the community. A coal village is a small social world in itself. Last winter an editorial in a national paper, commenting on a critical situation in the coal industry called coal districts "small kingdoms where owners rule supreme." Surely progress, here as elsewhere, involves the growth of democracy—democracy where the inherent dignity of every man is recognized; and where actions and thinking befitting that dignity are expected. This, then, as an objective—a community organized by itself for its own best interest. And for ourselves a sustained constantly receptive attitude toward the vague out-reachings of a community or group and a real awareness of the community building programs available in our state, from the state university or other public agency; of national programs for boys and girls. Nor are we passive parts of the community, but wish to be only one part, making vigorous if cautious advances, and avoiding the possibility of carrying even a good idea to the point of killing the spirit either of self-determination or of original effort by the trial and error method.

An opportunity to help any community involves a knowledge of the people in that community and perhaps our President knew the answer to the professional community worker's oft repeated and long sought quest for a "natural contact"; in any case the *Employes' Magazine* has made for us a natural and easy basis of acquaintance. And a closer contact with mining people has given us what we perhaps least expected, plenty of material on which to feed a growing belief in the inherent worth of folks. Just recently, while visiting, we picked up a book while our hostess went outdoors to settle some children's dispute. The book looked familiar and we found that it was one which was on the required reading list at our school some years ago and was considered a unique study of what was, at that time, an empire problem. We were lost in its pages when our hostess returned and said: "Do you know that? My cousin wrote it. He died in Africa——." We turned to the front page and read: "To my dear cousin—from the author A.—— C.——," with a Scottish address. We'd found a cousin of a book friend of our hero worshipping days, the cousin of a man who still is one of the heroes of an Empire's Church. We have found graduates of foreign universities. We have found heroes of the World War wearing first aid and mining community medals as proudly as they wear the honors of a nation's army. And we have found homes where the real fineness of a well

* Editor, Employes Magazine, The Union Pacific Coal Company.

There are 49 nationalities on the pay rolls of The Union Pacific Coal Company

McAuliffe's Pipe Band of Highland Scottish Pipers at the Union Pacific Company's Old Timers Association Annual Celebration

Pipers James Wallace, Alex Watt and James Noble, the beginning of the McAuliffe Scottish Pipe and Drum Band

bred mother communicated itself to her children in spite of difficult associations. We have found natural leadership of boys and girls and, in a few years, have seen boys and girls, young men and women, the children of miners, make notable places in educational and musical fields. The exceptions? Perhaps, but among these is to be found real leadership for those programs that make up the "activities" of our coal towns. Nor does this leadership object to direction-suggestion. Rather have we found a pathetic eagerness for help whether it be in women's club programs or ideas for money-making parties. And, whether we've accomplished it in adequate measure or not, the primary interest of the professional social worker, of the industry using it, should be the assistance and training of that leadership. It must be acknowledged a serious fault to stimulate a desire to help and then permit, if it is possible to avoid it, the feeling of futility that accompanies the breakdown of plans because of personal unpreparedness. To illustrate: It is easy to arouse an interest in the leadership of a Girl Scout troop in, perhaps, a young school teacher. Leadership training should then be supplied sufficiently often to avoid a willing leader's feeling that she's come uncomfortably to the end of her resources in program planning. Sincerity and eagerness and ideals are not enough—the technique that projects them is necessary.

Community Councils

It was with something of the foregoing in mind that we organized, five years ago, community councils in each one of our towns. These councils were composed of one or more representatives elected from the organizations already existent in the town as: United Mine Workers of America Local Unions; fraternal and church organizations; women's clubs; school teaching staff; Sunday Schools, and Parent Teachers Associations with the local mine superintendent and the magazine editress as ex-officio members. Suggested skeleton constitutions were offered and were revised and changed by the group to suit the individual town. Provision was made for the inclusion of other organizations, "community-wide in their interest," which might come later and the councils vary in membership numbers and in the activities undertaken in each village. There is no attempt to impose a program of effort. Suggestions are given as suggestions and effort made to induce group discussion, group opinion, group achievement, group results. Thus the level of community participation is reached and—more—is raised by giving additional courage of expression to the best elements and efforts in the community, through council unity and backing.

Activities sponsored by councils accommodate themselves to all phases of neighborhood aspiration—recreational, social, vocational, dramatic, musical, philanthropic and civic. Such relief as is necessary is done through the council, the council itself acting as a case committee. And perhaps it, better than any other agency or individual available in a tiny mining town, does try to consider the causes of need in individual families, and "by appropriate treatment seek to restore such families to independence." In any case since all the organizations of the little community are working together duplication of relief, by which families may lose their independence, is avoided and some tiny bit of the personal service which helps to "prevent a recurrence of distress" is given. Thanksgiving and Christmas baskets are also arranged by councils' committees, working with committees from the local unions or being supplemented by additional members from the local unions. We should also mention that special pleas for help are made to and answered by local unions—but of these councils are made aware by the local union representatives on the council. Indeed "treatment" almost invariably involves the cooperation of the union local.

A small sum of money is given to the councils monthly by the coal company and it is interesting to learn that additional sums are raised and used, ranging from a like amount to five times the sum given.

Bands

Following the organization of a most successful community band maintained in the town of Cumberland, our community councils have promoted town bands in four villages, helping finance the purchase of the larger instruments and arranging for instruction and leadership, using, as in Cumberland, the full time of a band leader resident in the town; a professional leader of a near-by town as in Winton and Reliance; or non-professional leadership as in Hanna. These bands are a recreational joy to non-members in the communities. But their largest contribution comes because they are the educational incentive for so many of our young folks acquiring musical training. In Cumberland, last year, there were 45 high school students, 42 of whom were members of the community band. Our president has also promoted, and with the help of a Scottish vice president, a remarkable band of Scottish pipers, 10 in number, who call themselves "McAuliffe's Pipe Band."

Recreation

By far the largest share of the "activities" of our community councils may be classed as recreational. And, again, the value of councils carrying community-wide representation in the membership is seen. Instead of holiday celebrations being many and for small groups and sections of the town, the

community is considered as a whole and recreations planned to cover it And, to a considerable degree, the councils or individual organizations with the backing of councils, have taken over the conduct of such commercialized amusements as dances put on by visiting professional dance orchestras which may be followed by undesirables who, away from home, are less careful of their conduct. We recognize that that recreational activity which claims the largest number of active participants is the best recreation. Dancing, dancing games and pageantry are excellent examples of such recreation. It goes without saying, however, that dancing planned by a local group under the sponsorship and supervision of the community council, attended by old and young alike as a community celebration, is a more reasonable recreation than that put on by an outside orchestra for gain. And perhaps we may mention the additional advantage that the home-managed dancing party uses its funds for some piece of community work. And again, councils need awareness and willingness for experimentation. And they do experiment. The town of Reliance carried, recently, a series of "old-time" dances, using a volunteer home orchestra and reviving old folk dances, early American dances and dancing games. At first the older young people did not attend, preferring to drive to the city, but before the series was over everybody was learning and enjoying the old dances. A public health nurse making a school health survey said that she believed much of the underweight and apparent undernourishment she found was really due to lack of sufficient sleep. She complained about the presence of young children at community gatherings and that they were allowed to remain until a late hour. The women's club of one town plans each year a New Year party, calling it a dance, for all the children of the community with the understanding that they will not attend the grown-up's party. And, this year, the Girl Scouts of the various towns will make the conduct of a children's games' Saturday afternoon during the Christmas holidays their "Second Class" bit of

Sacred vessels from the old Chinese "Joss House" which the Chinamen donated to Mr. Geo. B. Pryde when they left for home

Children's Day in the new Old Timers Community Building

community service. Modern psychology believes expression for the fundamental play instincts to be essential to the stability of the adult. And we have long believed that, "play is the serious business of childhood," not just a harmless means for filling the time not occupied by study or work to "keep them out of mischief," but ranking with education as part of the process by which normal development is assured. Play for everyone, an opportunity for wholesome good times through athletics, music, drama, and social activities should belong to any community.

Boy and Girl Scouting

The use of the national programs for Boy and Girl Scouts is in part an answer to the need for wholesome recreation, although certainly it is not the only fundamental need these programs meet. Boy and Girl Scout troops are conducted in our towns under the local sponsorship of community councils and the direction of the scouting councils of the district. These national programs are too well known to require comment here. We mention some district achievements. Last year 20 first aid teams, 13 teams of girls and 7 teams of boys, took part in the Scout section of the inter-company first aid meet doing work acknowledged by United States Bureau of Mines officers to be comparable to that of first aid men of experience. One hundred and twenty boys and girls working efficiently and fighting energetically in a contest which demonstrated expertness in an art which will stand them in good stead all their lives, enable them to render real service in out-of-the-way places—and (*Continued on page* 168)

Ten aged Chinamen who helped build The Union Pacific Railroad and, after a lifetime of service with it and with The Union Pacific Coal Company, are being sent home to China on retiring fund

Form 274

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

(Employment Department)

APPLICATION FOR EMPLOYMENT

GENTLEMEN: NO.

I hereby make application for employment as

I have had

experience in this line of work and refer you to

my last
present employer.

The following is record of my employment during the past three years.

I hereby authorize any of the above former employers to furnish The Union Pacific Coal Company my service record while in their employ and hereby release them, their officers, agents and employes, from any and all responsibility for so doing.

Witness.

NOTE—Applicant must state record of employment for the past three years.

References Hired for Date

Remarks

Nationality Date of Birth Marital Rel Citizenship

Figure 1 (front)

STATEMENT OF DEPENDENTS

Wife.

Name

Age Date of Birth

Residence Occupation

Children

1. Name Sex Occupation
   Date of Birth Residence
2. Name Sex Occupation
   Date of Birth Residence
3. Name Sex Occupation
   Date of Birth Residence
4. Name Sex Occupation
   Date of Birth Residence
5. Name Sex Occupation
   Date of Birth Residence
6. Name Sex Occupation
   Date of Birth Residence
7. Name Sex Occupation
   Date of Birth Residence

Dependents Other Than Wife or Children

I am making the following regular contributions toward the support of:

Name Relationship

Residence

Occupation Age Contribution $

Per Remitted through

Name Relationship

Residence

Occupation Age Contribution $

Per Remitted through

I hereby certify that the above and foregoing is a full and complete statement of all members of my family and other dependents who are wholly or in part dependent upon me for support, as

of 19

Witness

Signed

Figure 1 (back)

Form 274

NO.

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

REQUEST FOR REFERENCE and RELEASE

GENTLEMEN:—

has made application to this company for employment, and states that he was in your employ from to Occupation

Pay Roll No. at Plant, under foreman.

And that he left your employ

Will you please furnish us the following information regarding applicant's service record while in your employ, in accordance with attached Request for Reference and Release, and we will be pleased to reciprocate at any time. A stamped and addressed envelope is enclosed for your convenience in replying.

(Employment Department)

Was applicant in your employ during the above period?

Were his services satisfactory?

Reason for leaving your employ?

Would you re-employ?

Over

Figure 2 (front)

Form 276

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

REFERENCE RELEASE

19

I have made application to

(Name of individual, company or corporation)

for employment in the capacity of

I was in the service of your company from to

as at and hereby request and authorize your officers to furnish said individual, company or corporation with a complete history of my services while employed by , together with any information you may have concerning my personal character, habits, ability, disposition, etc., and particularly a statement of the cause or causes of my leaving the employ of your company including any statement of surmise or belief of any officials or employes of in connection therewith; and I fully understand and agree that the information furnished to be used as one of the means of determining my fitness for the position for which I have made application, and I hereby release you, its officers, agents and employes, the individual, company or corporation to whom you furnish the information above referred to, from any and all liability for damages of whatsoever nature or kind on account of furnishing the same.

Yours truly,

The signature of,

Insert name of Applicant

Signature of Applicant

was made by him in my presence.

Figure 2 (back)

EMPLOYMENT of LABOR

By H. J. HARRINGTON *

Brief description of methods used in employing and placing new men—Past records and physical examinations—Application forms submitted

A DEPARTMENT organized exclusively for employment and introduction of workmen is a new departure from methods of employment that have generally obtained in the coal mining industry, and is a quite recent innovation in comparison with the efforts made along this line by other leading industries of the country which have, for a number of years past, given this branch of the business considerable thought and have profited to a great extent from the money and effort expended in organization and maintenance of departments of this character.

The employment department of The Union Pacific Coal Company was organized several years ago, but, due to considerable opposition to this new method and accompanying lack of cooperation, the hiring of new men was conducted on a hit or miss plan, no arrangement whatever being made to anticipate possible heavy demands for increase in working force, so that whenever a shortage of labor was apparent or business conditions required increased output with a corresponding increase in working force, this department was called upon to recruit immediately, and without any previous notice or preparation, the additional number of workmen that would be required to meet the emergency.

Under these conditions, it was necessary that we take into the organization such workmen as were available on short notice and without any consideration whatever of their previous record with this company or other employers.

Compilation and analysis of employment records, however, developed the extreme weakness of this system and pointed to the fact that we, as well as other employers of the district, were creating and promoting the growth of a highly undesirable class of floating or itinerant workers, and producing an unusually high percent of turnover, with attendant heavy cost for time expended by clerks, mine foremen and superintendents in recording, introducing and instructing this class of workman, and indicated that some definite steps should be taken to cure this condition and to eliminate this class of workman; that individual records, giving a complete history over a reasonable period of previous employment with this company or other employers of applicant, should be available for guidance of the employment department in selection of new employes. Out of this has grown the present code of rules governing employment with this company.

Our rules governing the employment of workmen now provide:

That all workmen required for service in the mines of this company shall be hired through a central office at Rock Springs; modified, however, to meet possible emergency at Hanna, Wyo., and Cumberland, Wyo., mines.

That continuous good conduct is necessary to maintain the relation of employer and employe; that poor or indifferent attendance, without reasonable cause, intemperance, or behavior prejudicial to good citizenship will disqualify applicant or constitute cause for dismissal from the service of the company.

That in consideration of the extra-hazardous nature of the business of the employer, and the interdependency existing between mine employes, the selection of workers must be confined to those who are physyically and mentally alert.

That no consideration will be given application of anyone who has the appearance of or whose past record indicates inclination to dissipation.

That, in consideration of applications, preference should be given to those of citizens of the United States or to those who have declared their intention of becoming citizens.

That no person who has not reached the legal age provided by law shall under any circumstances be taken into the organization, and indicating an age limit beyond which no person may be employed except in cases of emergency.

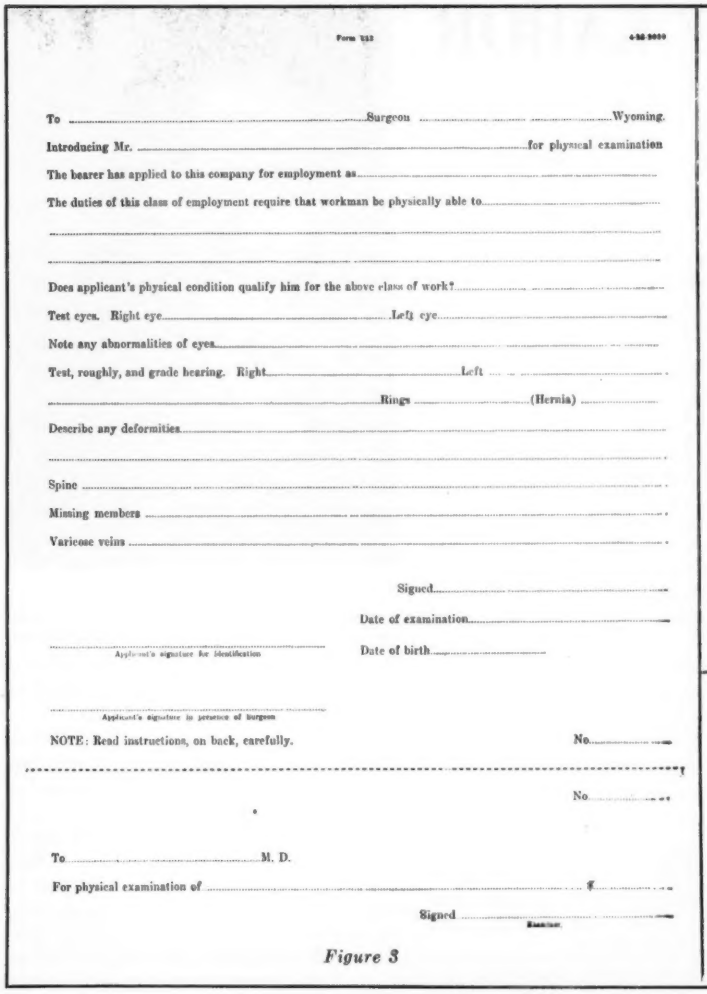
That certain physical defects will disqualify applicant.

That it shall be the duty of the management of the employment department to provide such forms as are necessary and to assist applicants in preparation of these forms.

Applicants are requested to fill out Application for Employment, Form 254 (*Figure 1*), stating thereon the class of work for which they are qualified, their experience in the line of work for which application is made, and giving reference to present or former employer in support of their statements. Applicants are instructed that it is necessary that they give a history of the past three years' employment, showing where and by whom employed, period of employment, occupation, pay roll number, plant name or number, name of foreman and reason for leaving the service. In the event that applicant has been in the service of more than one employer during the three-year period, he is requested to treat each period of employment as a separate item. This form carries a brief release for former employers in replying to applicant's request for reference, and shows nationality, date of birth, marital relations and citizenship of applicant. On the reverse of Form 254, provision is made for a statement of dependents at the time application is made.

Request for Reference and Release, Form 258 (*Figure 2*), is request of this department of former employers for verification of statement of applicant regarding previous service, provision being made for former employer's reply thereon. The reverse of this form carries a formal release over signature of applicant. These forms are mailed to former employer or employers, as the case may be, and upon the return thereof, applications are scored according to correctness of statements of applicants in comparison with former em-

* Supervisor of Employment and Compensation, The Union Pacific Coal Company.



Form 143 4-30-3000

To ..... Surgeon ..... Wyoming.

Introducing Mr. ..... for physical examination

The bearer has applied to this company for employment as .....

The duties of this class of employment require that workman be physically able to .....

.....

.....

Does applicant's physical condition qualify him for the above class of work? .....

Test eyes. Right eye ..... Left eye .....

Note any abnormalities of eyes .....

Test, roughly, and grade hearing. Right ..... Left .....

..... Rings ..... (Hernia) .....

Describe any deformities .....

.....

Spine .....

Missing members .....

Varicose veins .....

Signed .....

Date of examination .....

..... Date of birth .....

Applicant's signature for identification

Applicant's signature in presence of surgeon

NOTE: Read instructions, on back, carefully.

No. .....

No. .....

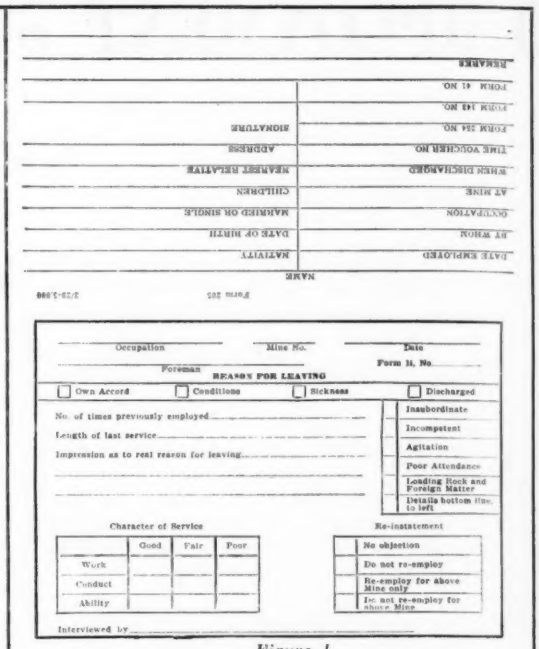
To ..... M. D.

For physical examination of .....

Signed .....

Examiner.

Figure 3



NAME

DATE EMPLOYED | NATIVITY

BY WHOM | DATE OF BIRTH

OCCUPATION | MARRIED OR SINGLE

AT MINE | CHILDREN

WHEN DISCHARGED | NEAREST RELATIVE

TIME VOUCHER NO | ADDRESS

FORM 134 NO | SIGNATURE

FORM 142 NO

FORM 41 NO

REMARKS

Occupation ..... Mine No. ..... Date .....

Foreman ..... Form 11, No. .....

REASON FOR LEAVING

Own Accord | Conditions | Sickness | Discharged

No. of times previously employed .....

Length of last service .....

Impression as to real reason for leaving .....

Insubordinate | Incompetent | Agitation | Poor Attendance | Loading Rock and Foreign Matter | Details bottom line, to left

Character of Service

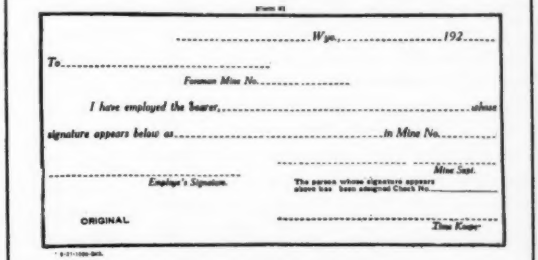
	Good	Fair	Poor
Work			
Conduct			
Ability			

Re-instatement

No objection | Do not re-employ | Re-employ for above Mine only | Re-employ for above Mine

Interviewed by .....

Figure 4



Form 41

....., Wyo., ... 192....

To .....

Foreman Mine No. .....

I have employed the bearer, ... *whose signature appears below as* ..... *in Mine No.* .....

..... Mine Supt.

Employe's Signature.

The person whose signature appears above has been assigned Check No. .....

ORIGINAL

..... Time Keeper

Figure 5

ployer. If we are satisfied from this investigation of applicant's record that he is worthy of employment, he is notified to call at the employment department for physical examination by the company surgeon.

A record of physical examination, Form 143 (*Figure 3*), is made by the surgeon and filed in the employment office. Loss of an eye or badly impaired vision of either eye, hernia or recent or congenital weakness likely to produce hernia, varicose veins, loss of either hand or either foot or other serious physical defect will disqualify applicant.

After applicant has passed the physical examination satisfactorily, his signature is taken on Personal Record Card, Form 105 (*Figure 4*), after which the card is filled in by the employment office and forwarded to the plant or mine, where applicant has been assigned work, for identification. Later, when workman leaves the service of the company, the reverse of the Personal Record Card is filled in by mine clerk or superintendent and the completed card returned to the employment department for filing.

Advice of Employment, Form 41 (*Figure 5*), is made in triplicate, the original being workman's identification, the duplicate being forwarded by mail to the official in charge of the mine or plant, and the triplicate remaining in the employment files.

Naturally, this system of investigation of past record of applicants like other innovations, has resulted in some unfavorable criticism, one of the arguments made against the system being that carelessness in replying, or withholding reply altogether, by former employers would work a hardship on applicant, compelling him to go through a long period of unemployment pending receipt of reply to his request. This is not true, however, as our experience has been that with very few exceptions former employers are prompt and fair in their replies. In view of the fact that our companies pension old and disabled employes who have been continuously employed for 20 or more years, we feel that a man seeking employment should be in average physical condition when he enters the company's employ. The age limit fixed by the company is 50 years and this limit may be exceeded in special cases.

MATERIAL DEPARTMENT

(*From page* 150)

point at which located. This card is made up in triplicate by the material clerk, he retaining one for his files and sending one each to the purchasing agent and to the general office. Whenever equipment is transferred from one mine to another, a shipping notice giving a complete record of such equipment is sent along with the transfer, and the clerk receiving the equipment makes up a card record in triplicate in the usual manner, and these cards are substituted for those originally made up when the equipment was first purchased.

All scrap, consisting of cast iron, mixed mine wrought, copper and brass, is concentrated at one point at each of the mines and sold periodically at the highest market price prevailing at the time.

Does The COMPANY STORE Satisfy The Demands of the Employe

By E. R. JEFFERIS *

Stores must supply more than mere necessities—Travel and extensive advertising has created a demand for comforts and luxuries—Standards of merchandising must keep pace with better living standards—Views of store interiors

THE MARCH of the filling station across the country marks the progress of a civilization, that demands new comforts, new ideas, new methods. With it came good roads, chain stores, better schools and a decidedly changed viewpoint of the average consumer towards the "Company Store." This vogue for travel that intrigues the entire nation has familiarized the consumer with every inexpensive luxury that constitutes a happy and successful home life. At the same time we lost our frontiers to the filling stations, the consumer discovered the comforts, pleasure and leisure that modern heaters, electric washers, and other labor and time-saving equipment brings.

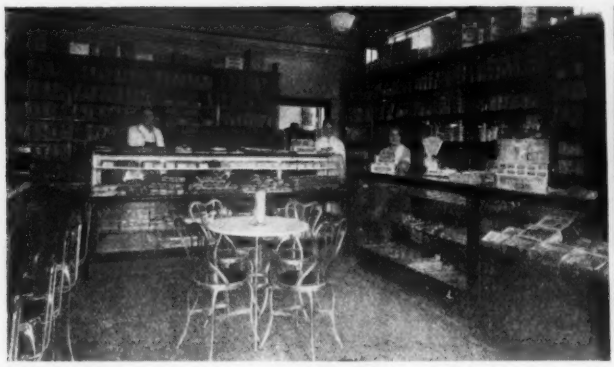
The movies have brought a knowledge of the whole world to every man, woman and child. They have furnished ideas, joy and romance, all of which have had a definite effect on our consumer and his merchandise viewpoint. Young men, within two days after a screen favorite appears in his new picture with fancy spats, ask for them at the Company Store.

The radio has done great things in a short space of time. In less than ten years a large proportion of our customers have acquired modern radio sets, which have made them acquainted with fishing barges, tooth paste, politics, naval armaments and saxophones. The acquisition of a mahogany set has brought a desire for other good furnishings, making the home more attractive and livable.

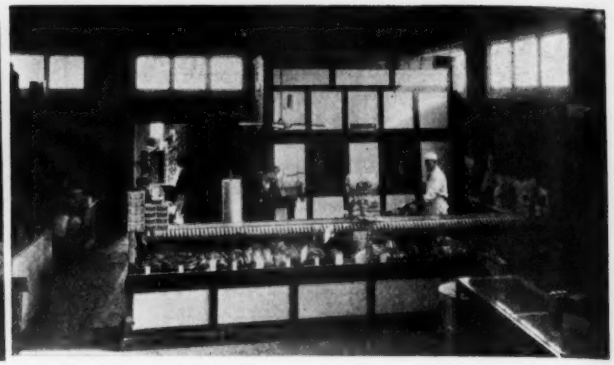
We are flooded with massive catalogues, circulars, tabloid papers and loads of other advertising literature, portraying the unusual values in anything from a ready-cut Spanish bungalow to a paper of pins. Any article, it is alleged can be laid down at your door, with tremendous savings—savings the sellers claim that will in a year's time take you on a trip to Timbuctoo or some other seaport. This is helpful rather than harmful to a well-managed store. The pretty pictures create a desire in

Upper photograph shows the interior of the Rock Springs store, and lower, the Reliance store

* Manager of Stores, The Union Pacific Coal Company.



Candy kitchen at new bakery, Rock Springs, Wyo.



Typical Union Pacific store butcher shop, Superior, Wyo.

the customers' minds for the merchandise that perhaps they have walked by in the store twice a day for two months without noticing until that colored picture turned the trick. A live local organization can capitalize this to their advantage, closing the sale at home.

Then comes the much-heralded chain store evidenced in every line of business from root beer stands to safety deposit boxes. Every weak-kneed wholesaler, banker and retailer writes articles, which our trade and other papers print, with a flourish of illustration and big type, extolling the high spots of chain organization, buying power, and sales. These writers forget to mention the merits of their own business, with the consequence they develop a complex of defense instead of staging an offensive with enough energy and enthusiasm to make the consumer feel that their own local stores have merit and deserve their patronage.

Has the company store met these new developments? Have they been able to capture the attention of their customers against this new challenge? Competition is very keen. The store executive must keep his ear to the ground for ideas to hold the consumer. The public is fickle and changeable, demanding a new idea every day. Hundreds of organizations are competing for the customer's dollar, with everything from "10 percent stock" to a package of Jello. Every week there is a drive on selling some commodity, from silhouettes to pawpaws. Large sums of money are spent in organization, advertising and "Whoopee" to put it over and it usually goes over big. Competitive stores can benefit, but unless you cooperate in organizing the opinion of your customers to special events, you will never be heard. The public does not respond without being pushed. You don't have to be a big town expert to cash in on these opportunities. Usually personality and initiative, coupled with the leads of successful merchandising organizations, make their campaigns more effective in your community.

Price is a big factor in sales. People drive all over the country burning up good gas hunting bargains. Quality hasn't the drawing power it once had—novelty is wanted now—executives and managers must recognize these facts. You can't raise a crop unless you plant, and in business you can't meet this new competition unless you have the merchandise the people want. The price, too, must be right, with a proper display to effectively draw attention. Direct advertising for company stores is the most effective. Direct advertising means hand bills, store papers and other direct mailing appeals. Support this advertising with only standard goods of excellent value.

Good management, advertising, price and quality are secondary to the sales force, which is responsible for the money in the cash register. They are the real contact between your store and the buying public. They can make or break you. They reflect the character and ability of those in charge. First teach your sales people confidence in your organization, merchandise and price. Encourage them to develop and show initiative which is the result of confident preparedness; their ideas often times develop into profitable sales to a company. Impress them with the true meaning of courtesy to customers—courtesy, not praise or flattery—as courtesy is the foundation of a company's good will with its customers and sincere interest in the needs and tastes of a customer is the backbone of service.

Honesty is inherent in over 90 percent of all humans, and if a decent, living wage is paid to employes for services rendered, this phase of the store operation is of minor importance. Complicated systems to detect dishonesty often work to the detriment of sales and profits. Figures covering gross profit and expense for the year reflect the waste caused by red tape and carelessness, including merchandise wasted by poorly kept stocks, inadequate fixtures and incompetent help; too much system adds an excessive burden to the pay roll and so does lax credit restrictions; such leaves you wide open to this new competition where low price and quality are the results of careful education to overcome just these weaknesses.

The crime of many company store operations lies in giving special discounts to executives and subordinates, assessing the man who does the actual labor an extra price for his purchases, which naturally forces him to pay more than a reasonable profit to make the store operation succeed. Worse yet is the comcompany that does this and forces its employes to trade with the store or lose their jobs. Bitterness and inefficiency result from these practices, as men imposed upon go to other fields, where modern methods and fair treatment prevail, carrying with them resentment towards all employers and all company stores. Maintain the same competitive price to all employes regardless of position. Sell on quality and price only.

Confidence in the employes of the company should be expressed in the form of installment sales of clothing, tires, radios, stoves, electric washers, etc. American standards of living now demand these simple luxuries; they add a comfort to a life that, at best, to the majority is a grim race to meet rent, living expenses and doctor bills. They likewise cover up a big bill of imaginary complaints that is ever ready to appear on the surface of any mining camp.

This new trend of the times is not a menace to the company store. We must, however, divorce our business from the old company store system and its traditions, and prepare ourselves systematically to enjoy the unusual advantages at our command. We know the company employes' likes and dislikes, their wants and desires, their ability to pay, so by proper advertising, well balanced stocks, enthusiastic sales force and a management full of energy, we can meet this new American business which will still be different tomorrow.

PLANT BUILDINGS

The Old Timers' Building at Rock Springs

Headquarters building including store and general offices, Old Timers Building, Rock Springs bath house, Bakery, Community Club Houses, Hanna Theatre—Complete descriptions of structural features and interiors

By JAMES L. LIBBY*

THE ENGINEERING DEPARTMENT of The Union Pacific Coal Company has been called upon, in the last few years, to submit estimates, design and supervise the construction for a great many different kinds of buildings, and still care for the regular engineering work. All construction work possible is handled by contract and complete working drawings and specifications prepared. The following are some of the kinds of buildings the department has handled:

THE UNION PACIFIC COAL COMPANY'S HEADQUARTERS BUILDING

The general officials, the mercantile store, the Southern Wyoming Electric Company and the Green River Water Works Company are all housed in the headquarters building at Rock Springs, Wyo. The construction is of concrete and brick with structural steel beams and supporting columns. The footings, structural members, walls and roof are designed to care for an additional story in case one is wanted in the future. Instead of the roof being finished in the usual graded manner, it is level and the same type of construction as the floors. Layers of felt and celotex are used to secure heat insulation and over this is laid a built-up 20-year roof with a gravel top.

The walls are of rough, golden buff-colored brick, laid in mortar of a similar shade. Light granite-colored cast stone trim and ornaments, stucco panels, a marquise and the window grouping with white trim on the woodwork give the exterior effect.

Due to the fact that the ceiling height required for the store is much greater than for the rest of the building, the store floor is raised about 3 ft. above the sidewalk to take up the difference in story heights. This arrangement provides for a well-lighted and ventilated store basement, with a structure two stories in elevation for the store and three for the rest of the building.

The frontage on Pilot Butte Avenue is 96 ft. and on "N" Street 125 ft., with a depth of 51 ft. and 71 ft., respectively. The intersection of these two streets is an obtuse angle of 114 degrees, making a wide angled V-shaped building.

The main entrance of the store is recessed with 35 ft. of display window on either side. These display windows have white oak floors with a walnut border, are paneled and finished in ivory enamel with color decorations. The entrance and show windows are all under an ornamental marquise.

The main store floor is 4,200 sq. ft. in area with mezzanine offices across the west end. From these offices a view is had of the entire store. Under the mezzanine is the rear entrance, stock room, elevator and the French Room with its auxiliary dressing rooms. A main stairway at the front of the store

Part of the Accounting Department, Headquarters Building, Rock Springs

* Assistant Chief Engineer, The Union Pacific Coal Company.

leads to the large basement sales department and rest rooms. The rear basement is used for storage and is provided with an electric elevator and a chute from the outside for handling merchandise, also an electric refrigeration machine.

The store floor is concrete covered with embossed linoleum of tile effect, laid on deadening felt and cemented in place. The ceilings and walls are painted in light tints, with beams, columns, pilasters, caps and borders decorated in colors. The furnishing and fixtures are in dark oak with wax finish, planned to suit all structural conditions.

The main entrance and stairway to the offices is centrally located on the "N" Street side. The lower floor has one office, a shower room, and a large stock and work room with a separate outside entrance, divided off by heavy wire partitions, for the use of the Southern Wyoming Electric Company and the Green River Water Works Company. The main floor has six private offices and a large room for clerical work. The upper floor has a spacious room for the accounting department with 2,810 sq. ft. of floor space, a large library or meeting room, five offices, an engineers drafting and a large work room equipped for blue printing, photostat and laboratory work, with an auxiliary supply room and a dark room.

The interior woodwork is oak finished in a light color, with waxed clear maple floors. The ceilings and walls are plastered with a sand finish and painted in pastel shades. All the hardware is cast bronze and cylinder office sets are used on the doors, with the main office entrance having a master lock that all office keys will fit. All the windows are weather stripped. The concrete floors throughout are treated with a slow-drying, penetrating oil that prevents dusting and polishes with use, and the oak stairways have the treads covered with heavy sheet lead which wears well and prevents slipping.

A valuable and useful feature of the building is the large vault space, built of reinforced concrete throughout, and consisting of three separate stories; the various departments are separated by concrete walls and heavy diamond mesh partitions and have access to their vault space through safe doors placed to suit their location. Each story has a floor space of 1,180 sq. ft. and is fitted with steel shelving and filing cabinets to suit the departmental needs. The space in the upper story is used by the engineering and accounting departments and the assistant treasurer; the general office, purchasing department and store have access to the intermediate portion, while the lower vault is divided into three parts where old records are filed and stored.

The different departments, the coal company's mines and stores in town and the outlying districts are greatly aided in the transaction of business by use of a private telephone exchange installed within the building, connected to the Mountain States Telephone System. This system is augmented by direct telephones on the coal company's switchboard telephone system.

The plumbing is complete and installed according to the best practice.

Interior of bath house at Rock Springs—showing shower compartment, benches and basket arrangement

Bakery, store and service station, Rock Springs

Part of Engineering Department's drafting room, with Chief Engineer's Office, Headquarters Building, Rock Springs

Vitreous china is used throughout, including lavatories in the offices. Flush valves are used in place of tanks. One of the useful things is the shower room which is accessible from the rear entrance and is fitted with showers placed in steel compartments arranged with private bathing and dressing booths. Individual steel lockers are provided for employes with extra lockers for visitors.

The system of heating is low pressure return steam with vacuum specialties, and a cast iron sectional 48-in. smokeless boiler and radiation. The boiler plant is placed in a concrete furnace room so arranged that the coal from the sloping bin will run into the feed hopper of the mechanical stoker which is of screw feed type. It is equipped with electrical operating thermostatic, pressure and time clock regulation, making it automatic in action. The boiler is equipped with an automatic water regulator, adjusted so that the water level is the same at all times. With this mechanical arrangement for the heating there is a great saving in janitor service. A 500-gallon hot water tank heating system is also located in the furnace room, using steam and a heater for heating the water. Hot water and steam are furnished from this plant for the Old Timers building, 110 ft. north.

The electrical work was handled by the Southern Wyoming Electric Company. All the work is in conduit, with neat, well-arranged fixtures, provision made for all present and future needs. The exterior is brightly illuminated at night by the display windows, marquise lighting, ornamental street lights, Southern Wyoming Electric sign and the large roof sign reading "The Union Pacific Coal Co.," which sign is 80 ft. long and has letters 4 ft. high.

Old Timers Building

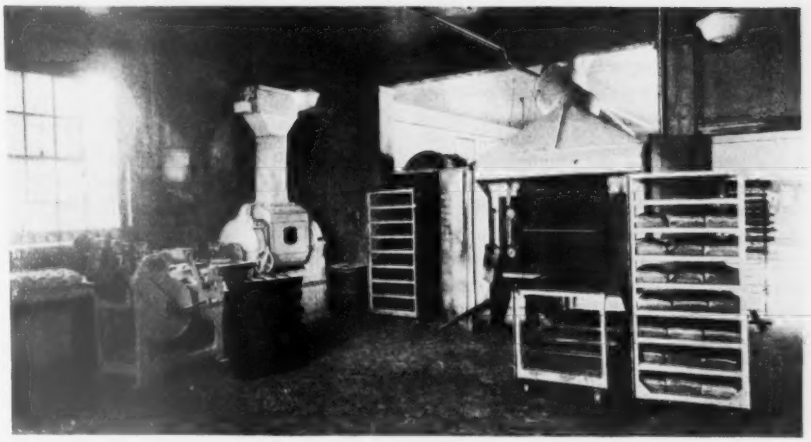
The "Old Timers" building at Rock Springs, Wyo., dedicated to the older employes, is designed to care for the old timers annual meetings, large gatherings, banquets, entertainments, basket ball games, athletic sports, and can be used for auto shows and other civic activities.

The building is a single story in elevation, with a concrete foundation, brick walls (including the inside walls of the auditorium), and steel roof trusses; has a frontage of 110 ft. and a depth of 120 ft. Ample grounds at the sides of the building and across the street are arranged for parking automobiles.

The exterior treatment consists of varying tones of red, rough-textured brick laid in black mortar; with white cast stone copings, pilaster gablets, pinnacles and ornaments; terra cotta green gray-colored square inserts, a light colored running brick course and a diaper brick panel over the entrance. All of these with the pilasters, parapet walls, gables and a broad expanse of roof covered with jade green-colored shingles with diagonal lines of contrasting shingles complete the design.

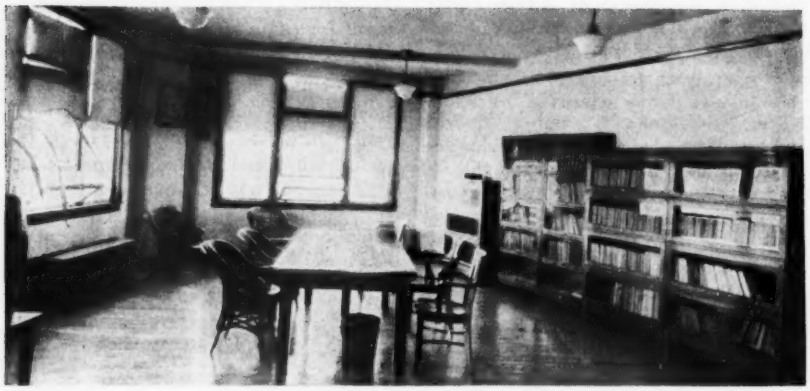
The plan consists of a recessed entrance with a ticket office at the side, a lobby with a ladies' parlor and a men's lounge with auxiliary check room on

Club room of Community Building, Superior, Wyo.



View inside the bakery at Rock Springs

One end of kitchen, "Old Timers" Building, Rock Springs



Part of the Library, Headquarters Building, Rock Springs

either side, the main auditorium with a stage, a large kitchen, rear vestibule, store room, showers and rest rooms.

The auditorium is 79 by 89 ft., and has a maple floor laid log cabin style for dancing. The stage, with a light blue velour sliding curtain, is arranged by removal posts and vertical rolling partitions to increase the proscenium opening from 35 to 66 ft. This allows nearly the entire stage to be used when desired. Storage and dressing rooms are provided under the stage. The equipment consists of removable bleacher seats for the auditorium and stage, folding chairs, folding banquet tables and a sectional raised ring with special lighting for boxing contests. The capacity for some of the events is: basket ball 1,300, banquets 800, boxing contests 1,800, and for entertainments using the stage 1,800. All auditorium equipment, when not in use, is stored in the store room or under the stage.

The auditorium walls are finished with rough-textured brick laid with white mortar, with decorated pilaster caps. The ceiling has a heavy concave celotex cove and small square blocks of perforated celotex with four decorated ornamental ceiling grills. The perforated celotex is used to correct the acoustics by absorbing the reverberation. A border design is used on the ceiling, the stage partition and the proscenium being decorated in bright colors.

A fully equipped kitchen, with walls in cream enamel and woodwork stained light green, furnished with serving counters, serving tables, steam table, hotel range, coffee urns, plenty of cupboard space and drawers, sinks, dishes and service for 800 is provided and arranged to handle large banquets rapidly.

The ladies' parlor and men's lounge have the plastered walls painted pastel shades, are finished in light oak and furnished to suit the requirements of each. Ample showers are provided with steel compartments and dressing booths to care for the needs during athletic activities.

Rock Springs Bath House

The employes' bath house at Rock Springs, Wyo. (the largest one built by The Union Pacific Coal Company), is located near the lamp house for the convenience of the men in going to and from their work.

The building has a frontage of 129 ft. and a depth of 42 ft., with walls constructed of red, rough-textured brick laid in white mortar. The unplastered interior walls are finished the same as the exterior. Concrete is used for the foundation and floors; and steel sash, glazed with semi-obscure wire glass, for the windows. All the trusses and roof members are of steel construction. The roof is made up of 2-in. dressed and milled fir lumber, laid on the steel purlins, and this sheathing is covered with asphalt felt and over this a galvanized iron roof, which construction gives good insulation and little or no trouble is experienced from moisture during the colder weather.

Community Building, at Winton, Wyo.

The design necessary required caring for the needs of 500 men, but finding from experience at Reliance and Winton where a portion of the bath houses were specially constructed for the women and girls, also the boys, the desirability of this feature was established and the idea incorporated in the new building. A special bay is set apart for the use of the women and girls, and a room constructed for the boys. The women's room, with dimensions of 15 by 30, is fitted with six steel showers, each consisting of a shower stall and a dressing compartment. The boys' room is 10 by 15, with a shower compartment having three showers and the rest used for dressing. The men's change room is 35 by 112, being entered through three vestibules with two sets of double doors each. Along the entire 112-ft. length is a covered shower compartment 6 ft. wide, with four roof ventilators to carry off the vapor, containing 43 tempered and 16 hot and cold showers.

Following the most satisfactory practice, each man is provided with a basket. This basket is nearly square, made of heavy wire mesh with a double bale for hanging. A hook is provided at each of the four lower corners for hanging clothes and belongings, while the basket itself is used to hold smaller articles. These baskets are hung on a chain, passing over two overhead pulleys, allowing them to be lowered for access, but are normally raised and the free end of the chain locked to the pipe railing back of the benches.

It is necessary in a building of this sort to have a good circulation of air and heat to dry out the damp clothing, also that ample hot water is furnished. The airing is provided by means of cross ventilation from the pivoted steel sash, also the large roof ventilators all of which have damper regulation. The heating for the building as well as the water is furnished by means of steam from the boiler plant.

Live steam from the boiler house is led into a small concrete trap room under the main floor, through a 2-in. pipe, covered with 80 percent magnesia pipe covering, 2 in. in thickness and laid in 8-in. split tile. The condensation is dripped into a ¾-in. high pressure open float steam trap and forced outside into a receiver tank. After the steam is dripped it is carried through a 2-in. riser to a point overhead, this steam at about

140 pounds pressure passes through a 2-in. steam pressure regulator, and is reduced to 12 pounds (as a safe pressure for cast iron steam radiation) and is arranged to pop at 15 pounds.

From this point the mains are carried around the building overhead, and the system of heating is a low pressure return pipe system with traps on the radiators, and return mains vented by means of vacuum vapor valves. All the radiators are of the wall type, and are hung so that the bottom is 5 ft. off the floor. This keeps them out of the way and avoids more or less the danger of burning. The condensation from all the radiators, as well as the water heaters, is collected in a 100-gallon steel tank placed in the previously mentioned trap room and from here it flows into a No. 101, ¾-in. size tilt trap, from which it is forced into the same receiver that the condensation from the high pressure steam enters. This kind of a trap was selected so that in case it is desired, in the future, the trap can be calibrated and by putting a recording counter on the trip lever, the actual pounds of steam used may be determined. The condensation water thus saved is pumped for use in the power house by means of a single phase electric automatic sump pump, size No. 2 E.

The large quantity of hot water necessary for bathing is furnished by means of two 940-gallon steel storage tanks. The water in each tank is steam heated by means of two No. 4 apartment heaters. Each tank has a No. 11 tank regulator, which has a thermostatic bulb placed inside the tank, and is set to shut off the steam supply for the water heaters when the water in the tank is heated to 180 degrees in temperature. With the water in the tank at 180 degrees it is necessary to mix cold water with it to get a bathing temperature of 90 degrees.

When water is drawn from the tank it passes through a regulator and is automatically mixed with the proper amount of cold water to give tempered water for the showers. If the tank temperature is 180 degrees and the cold water 45 degrees the valve lets in double the amount of cold water that it does hot. By this means, there is available for instant use three times the capacity of the tanks, and while this is being used the heaters will heat additional water to 90 degrees at the rate of 900 gallons per hour for each tank.

A complete system of sanitary plumbing is provided. The floor in the change room is graded so that it may be washed out with a hose, with all the water running into two sumps which are designed to be easily cleaned from time to time.

The electric wires are all drawn into a complete grounded conduit system run exposed from the panel board cabinets and painted to match the walls. The lighting fixtures are of the vapor proof condulet type, complete with globe and guard. Thus constructed, the entire electrical installation is, as required for a building of this kind, moisture proof.

Bakery, Store and Service Station at Rock Springs

A complete modern bakery is operated by the store department to better care for the needs of the employes of the coal company at the different towns. The bakery, store and service station is located on the Lincoln Highway near the mines, and is especially convenient for the employes who are somewhat remote from the company's store and the business district.

Suggestive of Spanish in design, the building is of brick and tile construction with exterior flesh colored stucco finish. The combination of stucco, bright ornamental trim, artistic roofing of green and red hexagonal slate-surfaced asphalt shingles, furnish a harmonious outward attractiveness, and the spacious driveways and parking space with gas pumps so situated as to serve four cars at one time make the building adaptable to the requirements of a modern and up-to-date service station, with full equipment for tire repairing (including vulcanizing), greasing and washing cars.

The bright colored store has accessibility between the bakery and service station, with an outside entrance. Here one may purchase gasoline, auto supplies, groceries, tobacco, candies, fruit, bakery goods, light lunches and be served refreshments from a soda fountain.

The bakery occupies two large, well lighted and ventilated rooms, equipped with the latest electric machines and an electric oven. Provision is made for an additional oven to be installed in the near future. A few of the items of equipment are a high speed bread mixer, with an electrically operated sifter, for handling 200 pounds of flour at one time, a dividing and molding machine for handling the weighed bread dough, a proof box where a rack holding a complete baking of bread is rolled in to raise. Also an electric oven that holds 192 one-pound loaves of bread for baking, a combination cake machine and grinder for mixing, beating and whipping as well as grinding. An electric frying kettle for doughnuts, etc., and an electric wrapper for the bread. These are augmented by a complete line of equipment and utensils for the preparation, handling and baking in large quantities.

Community Club Houses at Winton and Superior

The need of suitable quarters for social gatherings, also realizing the benefit and success of the club house at Tono, Wash., lead to the company's constructing special buildings to fill this need, and the resulting Winton and Superior club houses for use of the Women's Clubs, Boy and Girl Scouts and other community activities.

The exteriors are Spanish in treatment, with an abundance of color. The walls are finished in a rough and irregular smooth texture cream-colored stucco, with jade-colored tile inserts. The slate surfaced shingles on the roof are green in color, with small red diamonds, and the ridge and gable rolls are of alternate red and green. The trim for the doors and windows is painted light blue in color. The construction is a frame superstructure with hydro-plastic cement on expanded metal, finished with "California Stucco." The foundations are concrete plastered with a sand finish cement mortar.

The floor plans are practically the same, but due to the topography of the ground, the surroundings, and the resulting views, the larger dimension is used for the front at Superior and the gable is placed at front for Winton. The Winton building has the club room French doors opening on a balcony with a black iron railing, and protected by a red and green colored awning supported by two spears, while at Superior the French doors open on the entrance porch. Above the Superior porch is a gable pierced by a narrow opening. This opening has a circular ornate iron railing and a lantern swinging from the soffit of the arch. The porch floors are of red colored cement, blocked off similar to tile.

The club room, furnished with decorated wicker furniture, is 23½ ft. by 39 ft., with built-in box seats, having a back and the cover hinged to accommodate the storage of equipment below, placed on either side of the fire place. The fire place is built of light granite colored glazed brick, with Clay Craft ornaments of mountain and wood scenes. The interior decorations and the stain for the woodwork were selected by the women at each place. The floors are of clear maple waxed and covered with rugs. Side lights of the candle type with polychrome fixtures are used for lighting the club room and the entrance hall. A ceiling fixture of the same pattern is also placed in the club room.

The kitchens, all painted in enamel and the floors covered with bright colored inlaid linoleum, are 12 by 22½ ft., furnished with an enameled iron range, built-in cupboards, broom closet and ironing board. An enameled iron sink on legs with a double drainboard is placed under the window and a long drainboard with cupboards under is provided for handling the dishes. A heavy serving or work table and open shelving near the range complete the kitchen equipment.

Hanna Theater

Spanish design, having cream colored walls of stippled texture; with coping, window and door ornaments of white stucco, narrow recesses of green, a bright colored awning and a window balcony with a black iron railing, characterize the exterior of the theater building at Hanna, Wyo.

The building has a two-story elevation in front, covers an area 72 by 120 ft. It contains a theater, dance hall, pool room, refreshment parlor, barber shop, rest and cloak rooms on the first floor, and the second floor has a lodge room, 22 by 35½ ft., with ante and six property rooms in connection for different lodges and societies, also a kitchenette.

The theater has a seating capacity of 346 and the leather upholstered opera chairs are placed on a bowled floor, it is complete in its appointments to handle road shows and silent and photophone pictures. The stage has a proscenium, 22 ft. wide, a scene loft with a grid and several dressing rooms. The projection room, located over the ticket office, is entirely fireproof, equipped with a photophone, type F, with both sound on the film and disc equipment, Motiograph De Luxe Model projectors, an Actodector motor generator furnishing the d. c. current.

The system of heating is low pressure steam with vacuum specialties. Unit type heaters with electric blower fans are used to heat the theater and dance hall and the other rooms have direct "Corto" radiation. The cast iron sectional, smokeless boiler is placed in a concrete furnace room with a separate outside entrance.

Ventilation is provided for the theater by means of a blower fan with an air diffuser, taking fresh air from the outside and a ceiling grill with a damper regulated ventilator for the exhaust. The dance hall and lodge room have exhaust fans for ventilation.

Complete electrical devices and equipment are provided for the stage lighting, including dimmers for both stage and house lights, remote control for the curtain, and loud speakers placed near the screen, as well as the previously mentioned equipment in the projection room. All electrical work is in conduit on separate circuits, having enclosed safety switches, located in the furnace room. Neat lighting fixtures, conforming to the interior color scheme, are used.

The construction is a concrete foundation, with a concrete floor for the theater, a heavy frame superstructure, with built-up wood trusses, metal lath and plaster inside, and sheathing, asphalt felt and stucco on expanded metal for the exterior. The flat roofs are covered with a 20-year gravel top built-up roofing.

LEGISLATIVE REVIEW

(*From page* 91)

izes the improvement of the Youghiogheny Rivers in Pennsylvania. Rivers and Harbors.

S. 2964. Mr. Robinson (Dem., Ark.). This bill provides that after July 1, 1932, express and baggage cars must be constructed of steel, steel underframe or equally indestructible material. Interstate Commerce.

H. Res. 114. Mr. Parker (Rep., N. Y.). This bill proposes an investigation by the Committee on Interstate Commerce of the stock control and capital interests in railroads by holding companies, investment trusts, etc., to determine their effects on interstate commerce, for the purpose of enacting legislation to meet the situation. Rules.

H. R. 6175. This bill proposes to pay $268,500 to the Mack Copper Company for use of its property in San Diego County, California, as an army camp from 1917 to 1922. Reported by the House Committee on War Claims.

H. R. 7170 & 7171. Mr. Guyer (Rep., Kan.). These bills propose to pay $6,300 to the Smith-Leavitt Coal Company under a War Department contract. Claims.

S. 3088. Mr. Goff (Rep., W. Va.). This bill proposes to pay $9,400 to R. B. Miller on account of excess freight charges on manganese shipped from Virginia to Pennsylvania and Alabama during federal control of railroads. Claims.

S. 2864. Mr. Kendrick (Dem., Wyo.). This bill proposes to pay $15,000 to the Kinney-Coastal Oil Company, $2,910 to R. E. Wertz and $2,495 to the Castle Oil Company, representing payments for the purchase of oil and gas leases in Wyoming, but not delivered by the Interior Department. Public Lands.

S. 3131. Mr. Sullivan (Rep., Wyo.). This bill proposes to pay $2,900 to the Buck Creek Oil Company, representing excess royalties paid on oil and gas leases in the Cheyenne, Wyoming, district. Claims.

H. R. 8169. Mr. Box (Dem., Tex.). This bill authorizes the Orange Car and Steel Company of Texas to sue the government in the Court of Claims in connection with a contract to build ships for the government during the war. Claims.

H. R. 8461. Mr. Somers (Dem., N. Y.). This bill proposes to pay $10,150 to the Concrete Steel Company for furnishing steel to the railroad administration for the construction of barges during the war. War Claims.

H. R. 7874. Mr. Andresen (Rep., Minn.). This bill appropriates $1,200,000 to pay increased wages allowed during the war by the government to employees of the Minneapolis Steel and Machinery Co., St. Paul Foundry Co., American Hoist and Derrick Co., of St. Paul, and the Twin City Forge and Foundry Co., of Stillwater, Minn. War Claims.

REGULATIONS GOVERNING USE OF TROLLEY WIRES IN MINES

A summarization of the regulations of the various states governing the use of trolley wires in mines has been made by L. C. Ilsley and R. A. Kearns, of the U. S. Bureau of Mines. From these various state safety codes a composite code for trolley circuits, based largely on the provisions of the Pennsylvania bituminous mine law, has been prepared. This material has been published as Information Circular 6220, copies of which may be obtained from the bureau.

State safety codes give more attention to the question of trolley-wire installation than to any other phase of mine regulations pertaining to the use of electrical equipment, according to the bureau. This attitude on the part of legislators is to be expected, because trolley circuits offer a greater hazard than other circuits common to electrical installations in mines. In fact, this danger is so great that in mines outside of the United States the requirements either prohibit or greatly curtail the use of trolley circuits.

The three major hazards presented by a trolley circuit are: shock to persons; the initiating of mine explosions; and the igniting of mine fires. Most of the regulations are intended to lessen the first danger.

Of all circuits in mines, trolley circuits offer the greatest shock hazard. Most other circuits can be provided with a certain amount of insulation which prevents a person from coming in contact with the bare wire, but trolley circuits must be bare for their entire length. Most other circuits can be installed in such a manner as to prevent contact with them, but trolley wires must follow essentially the alignment of the track, and usually because of the lack of head room they are so low that they offer a special hazard. In following the track, trolley circuits must pass under good and bad roof and encounter wet or dry conditions, as the case may be.

Some of these adverse conditions can be modified, but generally at a considerable expense to the operator. Narrow roads can be widened to give clearance along the roadway on the side opposite trolley circuits. Bad roof can be taken down and additional supports placed, and where the roof is very bad, an arched support can be used. Top or bottom rock can be removed to make greater height. Drainage conditions can be improved. All of these changes which make for a good safe trolley installation add to the cost of mining and could be carried to a point that would make this cost prohibitive.

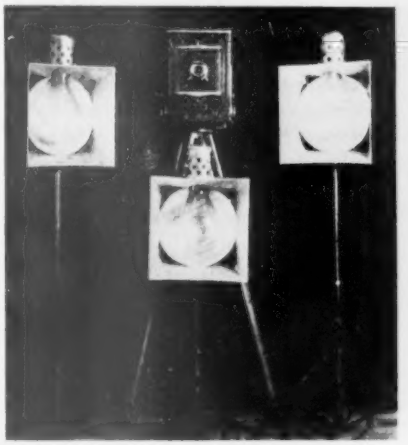
UNDERGROUND PHOTOGRAPHY

By V. H. WILLIAMS *

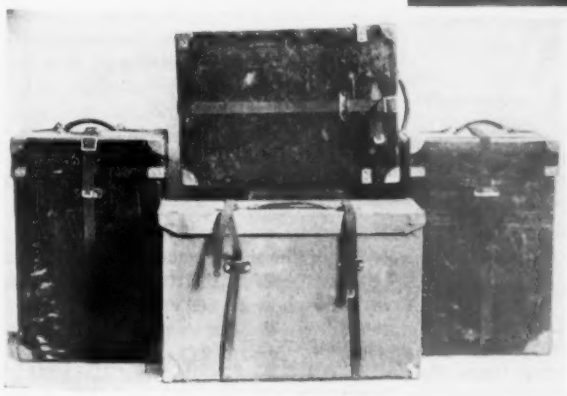
Brief description of equipment used, the problems encountered and methods employed in overcoming the difficulties of underground photography at The Union Pacific mines

FEW people know or realize the amount of time and labor spent in taking underground pictures. Frequently, to produce one picture, it requires several hours' work to make a single set-up. Our equipment for the most part is very fragile and delicate and we find it advisable to carry this equipment about the mine rather than to transport it in cars. For that reason, we use the three Ventlite Kompact outfits and camera shown in the pictures.

In order to make a picture of any subject we must have sufficient light; the Ventlite system or equipment has proven itself very efficient and durable. The photo-blue, actinic ray, 1,500-Watt, 230-volt globes are set in aluminum reflectors which are equipped with a socket and a switch and are specially built for photographic work. The stands supporting the reflectors are a folding type, easily adjusted to the required height. The camera used and shown is a 6½ x 8½ Eastman View, with an extremely wide angle lens which is very advantageous in taking close-ups in narrow places such as entries and crosscuts.



Above—Lights and camera set up to shoot a picture.



Left—Cases for carrying the photographic equipment in the mines.

In taking pictures underground one encounters adverse conditions, for example, the air is usually full of dust particles which tend to obstruct and hold back the light, the subjects are black and the coal gives a black background, all of these have a tendency to absorb the light. In other places one finds props so closely spaced that it is nearly impossible to place the lights about the camera so that all or most of the shadows may be cut out. Distortion is the most persistent obstacle of all to overcome, for, with a few exceptions, some object is much too close to the lens. The problem of changing position in an already cramped condition is not an easy one. There are many other things that might be mentioned, but, everything considered, photography underground is very closely related to work in the studio.

AMOUNT OF COAL DUST MADE IN A MINE DAILY

The total amount of coal dust that is made unavoidably each working day throughout most coal mines is very large but is difficult to estimate precisely and varies with every mine; the approximate amount may vary from one-fifth of 1 per cent of the run of mine produced to 1 per cent or more in mining a very soft, friable coal, says George S. Rice, chief mining engineer, United States Bureau of Mines, in a recently issued report. Not all of this dust is necessarily, at the start, dry dust which on strong air movements will rise in a cloud; considerable coal dust becomes covered in the gob, and in some of the more progressive mines water is used on the cutter bar of machines to wet the "bug dust" (machine dust), and the face is wet down by the hose; tight cars are used and the tops of the loads sprinkled by automatic sprinklers. Such mines do not have so much dry coal dust to neutralize by rock dusting. There is practically no bituminous coal mine, however, that does not make enough coal dust to produce a dust cloud of sufficient density to ignite and to propagate an explosion if the coal dust is not neutralized by rock dust.

* Construction Engineer, The Union Pacific Coal Company.

COMMUNITY ORGANIZATIONS

(*From page 155*)

then dining together in a Scout fellowship of fun! As a prize the boy winners of this contest were sent for a week's motor trip through Yellowstone National Park and the girl winners attended the international first aid meet at Kansas City, giving two demonstrations for the 50 teams contesting there. At the annual Girl Scout Mothers' and Daughters' banquet we have had such speakers as the Governor of our state and the dean of women of our state university, adding width to their horizon and the realness of personality to their desire to cherish the beautiful and strong in life.

Camping is always a part of scouting for boys and girls and a series of three two-week camping periods are conducted in the mountains north of Rock Springs despite the 145 miles of motor travel necessary to transport food and campers. The grandeurs of Wyoming mountains are at the end of the journey. Parents and friends drive the Scouts and the huge trucks of The Union Pacific Coal Company are used to transport food and supplies.

Women's Clubs

Women's clubs have been organized and are affiliated with the National Federation of Women's Clubs. This last because, despite a lack of usable or applicable program material in the Federation, a club having a direct contact acquires a secondary social personality from its consciousness of national unity.

Two splendid new club houses for the girls and women have been built in Winton and Superior. Representatives of the women's organizations and the Girl Scout captain were asked to help plan these buildings which are modern in every way, have an up-to-date kitchen, a cozy living-room with a fire place. These club houses and club rooms in other towns make it possible to accommodate such classes as are available through the adult education and vocational extension classes of the State Department of Education, as the women's clubs are the medium through which this service and others available are claimed for the women of our towns. Classes in food selection, home management, sewing and child care have been conducted.

Employes' Magazine

Our *Employes' Magazine* has now completed its fifth year and there is abundant evidence of its popularity with an increased feeling that it belongs to everyone, is a publication in which each employe, his wife or child may, with right, ask for inclusions. It is no longer the *Employes' Magazine*, but *The Magazine*—ours. Departments include: Editorial, written by President Eugene McAuliffe; Safety, by Safety Engineer J. A. Smith; Engineering, by various members of the engineering staff; Old Timers, in which is carried stories about the older employes and their families as well as stories told by them; Humor, of Interest to Women, Girls, which is the medium for the exchange of Girl Scout news and program material; Our Little Folks; News—and, each month some feature story, art study of seasonal or popular interest; or article of cultural value, with drawings and sketches by employe artists. Although only 120 employes contributed in a year material it was possible to sign, many more asked that happenings and folks be written and were glad to help find things of interest. Certainly its pages can be the medium for the stimulation of every worth-while and building factor in our group living.

Old Timers' Association

The Union Pacific Coal Company Old Timers' Association was organized five years ago for the purpose of "banding together in good fellowship all senior employes, thereby renewing and thereafter maintaining, the association and friendships of earlier days, an annual get-together meeting to be provided for this purpose." Men whose term of service with the company or related companies equals 20 or more years are eligible to membership. There are 435 members, many of whom have seen 35 years of service, not a few 40 years and one hale old gentleman 55 years of service. Because it includes in its membership those who worked for "related companies" there are men who helped build the Union Pacific Railroad and know the romance and struggle of the early days of the new West of America. Among these are still a few old Chinamen, the most of whom have during the last few years been sent home to China.

The annual celebration of the Old Timers' Association is an event of all southwestern Wyoming, and old timers, long out of service, come from the near-by cities of Utah and Colorado, as well as from other parts of our own state. Speakers of high standing and unusual appeal have been brought to Rock Springs for the celebration and the younger folks of the community delight in the opportunity to honor the old timers. One year it was a privilege to stage a pageant giving a pictorial presentation of the history and happenings of the company's coal districts since coal was first found, using 350 participants, many of whom were old timers themselves; the libretto written from the tales of old timers.

Sunday Schools

Thirteen Sunday Schools are conducted in the towns, some of them denominational, and many of them being Union Sunday Schools. Here, the finding and encouragement of leadership is the most complete service that can be rendered.

It follows, of course, that the organization back of the activities here outlined can not be set up once for all. Even in our rather stable mining towns changes in personnel are constantly taking place and new leadership is constantly being found. And, again, organization is deliberately changed. What we need to ask ourselves is whether or not we see the social tasks of our communities (social tasks are not peculiar to mining towns but belong to every community), with the significance of a company-owned town, its health and recreational problems; whether we are entirely willing to "go along with" the community endeavor initiated by others even when we see other ways; whether we constantly remember that while the student of social science must take training as long as that of physicians, it's practice must help others to work out their problems to their own development and advance.

MISSOURI SCHOOL OF MINES AND METALLURGY OFFERS FELLOWSHIP

In cooperation with the United States Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships, open to graduates who have the equivalent of a bachelor of science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work.

Fellows will become candidates for the degree of Master of Science (unless this or an equivalent degree has been earned). Their class work will be directed by the heads of the departments of instruction, but about half of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the School of Mines. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1930-31 the four fellowships will be granted in the following subjects: Ore dressing, problems in gravity concentration, flotation, ball milling, and magnetic concentration.

Applications, with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references will be received up to June 15, 1930, and should be addressed to the Director, School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

Mechanization Report No. 30-2

The Trend Toward INCREASED PRODUCTION With MECHANIZED LOADING

By G. B. SOUTHWARD

Records made in 1929 with mechanized loading—Tonnages and feet of entry development—Present record performances are indicative of future progress.

IN THE present use of mechanized loading equipment in coal mining there is a definite trend toward improving the operating methods. The real measure of these improvements can only be determined by the reductions made in the mining costs but as it is not possible in this article to use cost figures, the tonnages produced can be substituted for the purpose of illustrating the advancement which has now been reached in the operation of the machines. It is not always true that an increased tonnage from a mechanical loading unit is followed by a decreased operating cost but in most cases it does follow. In the average mechanized operation the time lost in avoidable delays is a rather costly item and an increase in the production usually means that some of these delays have been eliminated. A study of the tonnages loaded at a number of representative operations is of some value in indicating efficiencies which have not been reached but these tonnage figures have a further and greater value in that the outstanding performances are establishing records which in all probability will soon be equalled by the industry as a whole.

The figures in Table I show mechanized loading records which have been made during the year 1929 by a number of representative operations covering all the important coal fields in the United States. These include records made with different types of loading equipment but in order to avoid any appearance in this article of making or implying comparisons between the efficiencies of the different machines there are no figures submitted to show the number of men employed with any of these units. A comparison based on tonnage alone, without the man-hour figures, may be misleading.

In compiling these records it has been the attempt to include only mines that have been using mechanized loading over considerable periods. The time covered by these records varies from as low as seven shifts in an extreme instance to as long as six months; the average is approximately one month and it is believed that these records on the whole accurately represent the average performances that are now being made. The records cover loading performances of 31 mechanized loading operations including mechanical loaders, scrapers and conveyors. In order to conceal as far as possible the identity of these mines the

TABLE NO 1—PRODUCTION RECORDS IN 1929 WITH MECHANIZED LOADING EQUIPMENT

RECORDS MADE WITH MECHANIZED LOADING IN WIDE WORK

Mine No.	Type of Machine	Seam height	Working places	No. of Shifts	Average Shift Tonnage	Maximum Shift Tonnage	Capacity of Mine Cars
1	Conveyor	Low	Rooms, pillars	54	44 tons	85 tons	1.5 tons
2	Scraper	Low	Long face	16	115 "	148 "	2. "
3	Conveyor	Low	Rooms, pillars	36	125 "	158 "	1.75 "
4	Loader	Medium	Long face	24	180 "	240 "	2. "
5	Loader	High	Pillars	24	198 "	253 "	3.8 "
6	Loader	High	Entries	26	230 "	329 "	3.3 "
7	Loader	High	Ent., rooms, pil.	199	243 "	368 "	4. "
8	Loader	High	Entries, rooms	18	250 "	306 "	3. "
9	Loader	High	Rooms, pillars	26	257 "	303 "	3. "
10	Scraper	High	Long face	240	264 "	425 "	1.5 "
11	Loader	High	Rooms	19	280 "	336 "	2.3 "
12	Loader	High	Rooms	21	281 "	356 "	2.2 "
13	Loader	High	Entries, rooms	30	300 "	360 "	2.4 "
14	Loader	High	Rooms, entries	22	305 "	393 "	2.9 "
15	Loader	High	Long face	23	323 "	391 "	3. "
16	Loader	High	Rooms	25	433 "	540 "	4.5 "
17	Loader	High	Ent., rooms, pil.	120	540 "	650 "	3.75 "

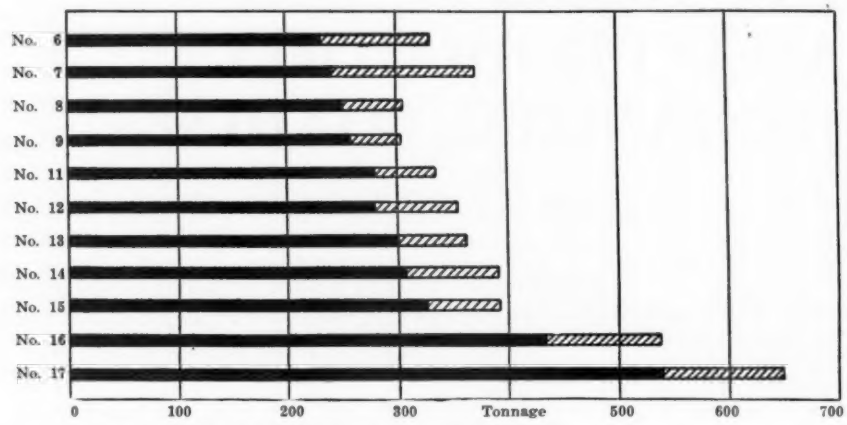
The figures in this table are records of performances with mechanized loading that have been made during the year 1929. These records include mines in all of the important coal producing states

RECORDS MADE WITH MECHANIZED LOADING IN NARROW WORK

Mine No.	Type of Machine	Seam height	Working places	No. of Shifts	Average Shift Tonnage	Maximum Shift Tonnage	Capacity of Mine Cars	Average Total Entry Adv.	Maximum Total Entry Adv.	No. of Entries Driven	Average Single Entry Adv.	Maximum Single Entry Adv.
18	Loader	High	Entries	41	47 tons	.....	1. tons	13 ft.	21 Ft.	1	13 Ft.	21 Ft.
19	Loader	High	Entries	50	49 "	.....	3. "	13.5 "	15 "	1	13.5 "	15 "
20	Conveyor	Low	Entries	184	60 "	.....	1.75 "	15 "	.....	2	.....	.....
21	Scraper	Low	Entries	7	32 "	.....	2. "	24 "	30 "	2	12 Ft.	18 Ft.
22	Scraper	Low	Entries	32	25 "	.....	1. "	24 "	36 "	1	24 "	36 "
23	Conveyor	Low	Entries	39	64 "	.....	1.5 "	27 "	36 "	1	27 "	36 "
24	Loader	High	Ent., room necks	38	229 "	267 tons	3. "	28 "	42 "	4	7 "	35 "
25	Loader	High	Ent., room necks	15	114 "	.....	4. "	34 "	62 "	1	34 "	62 "
26	Loader	High	Ent., room necks	111	240 "	378 tons	3. "	37 "	56 "	6	8 "	8 "
27	Loader	Medium	Entries	40	72 "	.....	2. "	56 "	.....	2	28 "	34 "
28	Loader	High	Ent., room necks	24	210 "	.....	3.3 "	48 "	72 "	4	12 "	28 "
29	Loader	High	Entries	10	118 "	.....	3. "	60 "	91 "	1	60 "	91 "
30	Loader	High	Narrow work	10	275 "	312 tons	4.2 "	72 "	88 "	10	8 "	8 "
31	Loader	High	Narrow work	77	173 "	203 "	4.7 "	59 "	68 "	8	12 "	18 "

CHART NO. 1

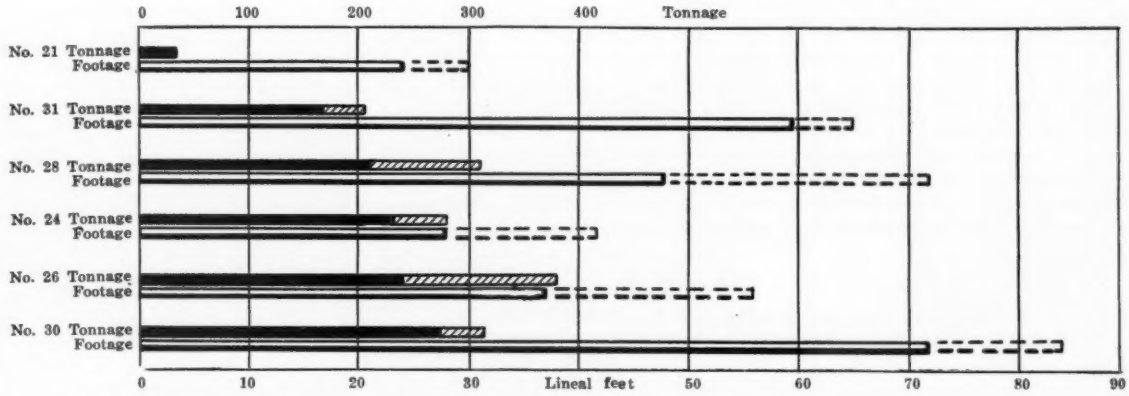
AVERAGE AND MAXIMUM SHIFT TONNAGES LOADED IN WIDE WORK



NOTE: AVERAGE SHIFT TONNAGE SHOWN BY SOLID BLACK
MAXIMUM SHIFT TONNAGE SHOWN BY CROSS SHADING

CHART NO. 2

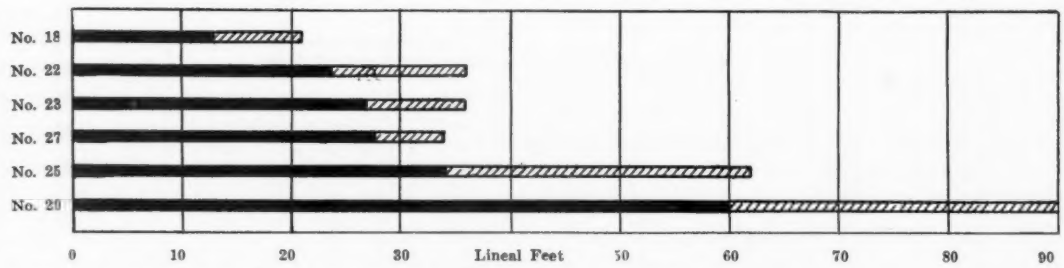
SHOWING TONNAGE AND LINEAL FEET OF NARROW WORK DRIVEN



NOTE: AVERAGE SHIFT TONNAGE SHOWN BY SOLID BLACK
MAXIMUM SHIFT TONNAGE SHOWN BY CROSS SHADING
AVERAGE FOOTAGE OF NARROW WORK PER SHIFT SHOWN BY SOLID LINES
MAXIMUM FOOTAGE OF NARROW WORK PER SHIFT SHOWN BY DOTTED LINES

CHART NO. 3

SHOWING LINEAL FEET OF SINGLE ENTRY ADVANCEMENT IN ONE SHIFT



NOTE: AVERAGE ENTRY ADVANCEMENT PER SHIFT SHOWN BY SOLID BLACK
MAXIMUM ENTRY ADVANCEMENT PER SHIFT SHOWN BY CROSS SHADING

heights of coal in the different seams are not given but differentiations are made between high, medium and low coal. In this table seams greater than 6 ft. are listed as high coal, seams from 4 to 6 ft. as medium coal, and seams less than 4 ft. are classed as low coal. The data shown in this table includes the number of working shifts covered by the record. In most cases the working shift is eight hours long but in a few instances where this was not the case the tonnages and entry development have all been reduced to an eight-hour basis. These records have all been furnished by coal operators and in no case were any figures submitted by equipment manufacturers.

The capacity of the mine cars is given to show the trend toward larger sizes which is now becoming quite apparent. The requirements of mechanized loading are better suited by large capacity than by small capacity cars. This refers more particularly to the width and length than to the depth. The usual practice now being followed with mechanized loading of moving the cars entirely with some form of mechanical power—either gathering locomotives or rope haul—is permitting heavy steel construction which would not be suitable for a mine with hand loading where the cars are moved by animal haulage or placed with man power.

For the purpose of studying tonnage performances it is necessary to take into account the class of service for which each machine is being used. In some operations the records are given for machines which are loading entirely in wide work, in others the loading is partly in rooms and partly in entry development, while a third class is confined entirely to narrow work. In this latter class there are two sub-divisions—one in which as large a tonnage as possible is desired and another where speed of development is of primary importance and the tonnage is a minor consideration. In submitting these records in Table I there has been no attempt to segregate the different types of operations and only two divisions are made—one where the operation is for the most part in wide work and the other where the operation is all in narrow work. Three charts, however, have been prepared to show graphically some of the representative records in three classes of operations—(1) tonnage loaded in wide work, (2) tonnage and amount of heading development in narrow work, and (3) linear feet of advancement made in driving single entries. All of these charts show the average shift performances made during the period and also show the maximum single shift record. Each graph is referred by number to the mine shown in Table I.

Chart No. 1 shows 10 mines in high coal where the machines are used in wide work. The average shift productions range from 230 to 540 tons per shift and the maximum shift loading is 650 tons. All of these machines are of the same general type (mechanical loaders) and are all operating under fairly similar physical conditions although of course no two conditions are exactly alike. There are three facts which lead us to believe that the maximum economic production per machine shift has not yet been reached. The first is the wide divergence in the tonnages loaded at these mines. For instance, the maximum single shift records of some of the smaller producers are exceeded by the average shift tonnages of the larger producers. The second fact is that even at the largest producers the single shift record is much greater than the average shift which indicates that the average shift tonnage has not reached a standard limit. The third fact is that most of these machines have a capacity of two tons per minute and this rate has not even been closely approached over an entire shift at any of the operations whose records are submitted.

Chart No. 2 shows six operations where the equipment is confined entirely to narrow work. Mine No. 21 is in low coal using scrapers for driving a pair of entries while the other five operations are in high coal with mobile machine units driving a number of places. In the latter type of operation there is usually only one cleanup per shift in each entry although sometimes two cuts are taken. In an operation similar to No. 21 a pair of entries will be advanced very rapidly; the mobile units in the other five operations do not make so rapid a rate of advancement in any one working place but a machine of this type driving entries, cross-cuts and room necks in either one or two panels will develop a very considerable territory in a comparatively short period of time.

Chart No. 3 shows seven records where the loading equipment is confined to driving a single entry. These operations vary from low to high coal and use mechanical loaders, scrapers, and conveyors. The first four are records which have been sustained over a comparatively long period of time and represents fairly regular performances. The last two are records which were made over short periods and are indicative of possibilities rather than representative of long time or standardized operations. Some of these records are rather spectacular and serve to illustrate the great amount of entry work which can be driven with mechanized loading where speed of advancement is the main consideration with tonnage as a minor factor.

Improvements which have been made in increasing the machine production during the past few years have largely come from improved operating methods as the machines are designed for about the same capacities as they were several years ago. The probability that the increase will continue is indicated by the maximum day's records which generally show an increase of around 25 percent over the average shift. These maximums are not, as far as could be learned, the result of a "set-up" but represent performances by the regular crew under more or less average conditions. It may be that at some of these mines their present tonnage is considered to have the proper operating balance required by the other equipment and facilities underground or it may be considered as the economic maximum for the mining system in use. This is merely a possibility as it is hardly probable that any of these operators believe that they have yet determined what the proper maximum tonnage per machine should be. As a matter of fact that is one of the main things which we are trying to find out.

METHOD AND COST OF MINING PITTSBURGH COAL BED IN FOUR EASTERN OHIO MINES

The methods and costs of mining Pittsburgh, or No. 8, coal bed in four eastern Ohio mines are outlined in Information Circular 6208, recently published by the Bureau of Mines. The coal bed worked at these four mines averages about 60 inches in thickness and is made up of three distinct benches of coal.

The room-and-pillar panel method of mining as used at these mines is the general practice in eastern Ohio mines. Because of the treacherous nature of the immediate roof and the expected difficulty of controlling and breaking the bed of limestone about 14 ft. thick which lies 3 to 9 ft. above the coal bed, no attempt is made to recover pillars. To delay a squeeze or cave while the rooms are being driven their required distance of 270 ft. on the advance side is the greatest problem in the mining method. This is readily apparent when groups of six to ten rooms are started and driven abreast and gradually widened leaving a room pillar which gradually narrows in size until often it is only 3 to 5 ft. wide before the rooms reach their projected distance. It is estimated that 55 per cent of the coal is extracted by the present system of mining.

Details of machine mining, blasting, haulage, pumping and ventilation equipment, power consumption and pay systems are given, also tables presenting contract rates for developments and mining and showing a summary of mining costs for labor and supplies.

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

Heating Becker Coke Ovens with BLAST FURNACE GAS

By F. B. THACHER *

Blast furnace gas taken to heat coke ovens at South Chicago plant—Ready sale for rich coal gas from Becker ovens as domestic fuel determines change in practice—Coal gas at 570 B. t. u. and blast furnace gas at 95 B. t. u.—Important washing and cleaning of furnace gas described—Ovens suffered no harm and coke more uniform in size, porosity and density

OUR two batteries of Becker ovens at the South Chicago plant have been heated with blast furnace gas exclusively for the last seven months with a smoothness and economy in operation that has more than met expectations. The cleaning and delivery of the gas, and the heating of the ovens, have been carried on without interruption or difficulty of any kind. The improvement in uniformity of coke, together with the fact that there is now use for as much blast furnace gas as may be produced have resulted in easier and more regular operation of the two furnaces. It will be the purpose of this paper to describe in some detail the installation and operation of this system of heating ovens.

Our company began the construction of the necessary gas-washing plant and gas piping, including a tunnel under the Calumet River at 111th Street, in December, 1927, and gas was turned into the flues on October 26, 1928. The gas washing plant and the piping of the gas to the regenerators was engineered by The Koppers Construction Company, and a dry gas holder for storage of blast furnace gas at the coke plant was erected by the Bartlett-Hayward Company. At the same time we erected a modern steam plant at the furnaces, to generate from coke breeze the power formerly obtained from a part of the furnace gas.

The reasons underlying the investment, particularly under the circumstances, may be better understood by briefly outlining the economic conditions. One of the requirements of maximum economy in the production of pig iron is that furnaces, mills, and coke ovens should be located on adjacent sites, so that the best use may be made of the immense quantities of energy released in the form of gas. Only about 67 percent of the energy in the coke charged to the furnace can be utilized therein, and coke ovens yield energy in the form of surplus gas equal to 23 percent of that in the furnace coke produced. These figures take into account all of the heat returned to the furnace as hot blast, and that returned to the ovens for heating them with coal gas. This surplus gaseous energy totals 56 percent of that in the coke to the furnace, or 83 percent of that consumed in the furnace. Stated in another way, for every B. t. u. consumed in the furnace, there is set free 0.8 B. t. u. in the form of surplus gas. This energy is distributed 60 percent in surplus furnace gas and 40 percent in surplus oven gas, and must be utilized to the very best advantage, for heating or generation of power.

Commonly, the furnace gas has been used to drive gas engines, or to produce steam, and indirectly electric power. The coal gas has been used in open hearth furnaces, mills and in soaking pits. However, in recent years its greater value for distribution as domestic gas has been recognized, and the quantity diverted to this purpose has increased rapidly. Since an average of 37 percent of the gas obtained from coking coal is used in heating the ovens, where this form of heating is practiced, it will be seen that by releasing this gas, the total volume available for sale would be increased 60 percent.

In our case, the two stacks at Federal Plant are isolated and use of the furnace gas has been limited to generation of steam and electric power to operate the furnace plant. There are two 80-ft. stacks, consuming 865 net tons of coke and giving off 120 millions cu. ft. of gas per day, or 139,000 cu. ft. per net ton of coke. The distribution of gas was 35 percent to stoves, and 65 percent for steam plant, bleeding and leakage. Over a recent six-month period, with the steam plant in need of replacement, the steam produced amounted to a little over 3,000 pounds per net ton of coke to furnace, or 35 percent efficiency when referred to the total available in the gas without deduction for leakage.

At the coke plant the two Becker batteries, of 55 ovens each, were coking

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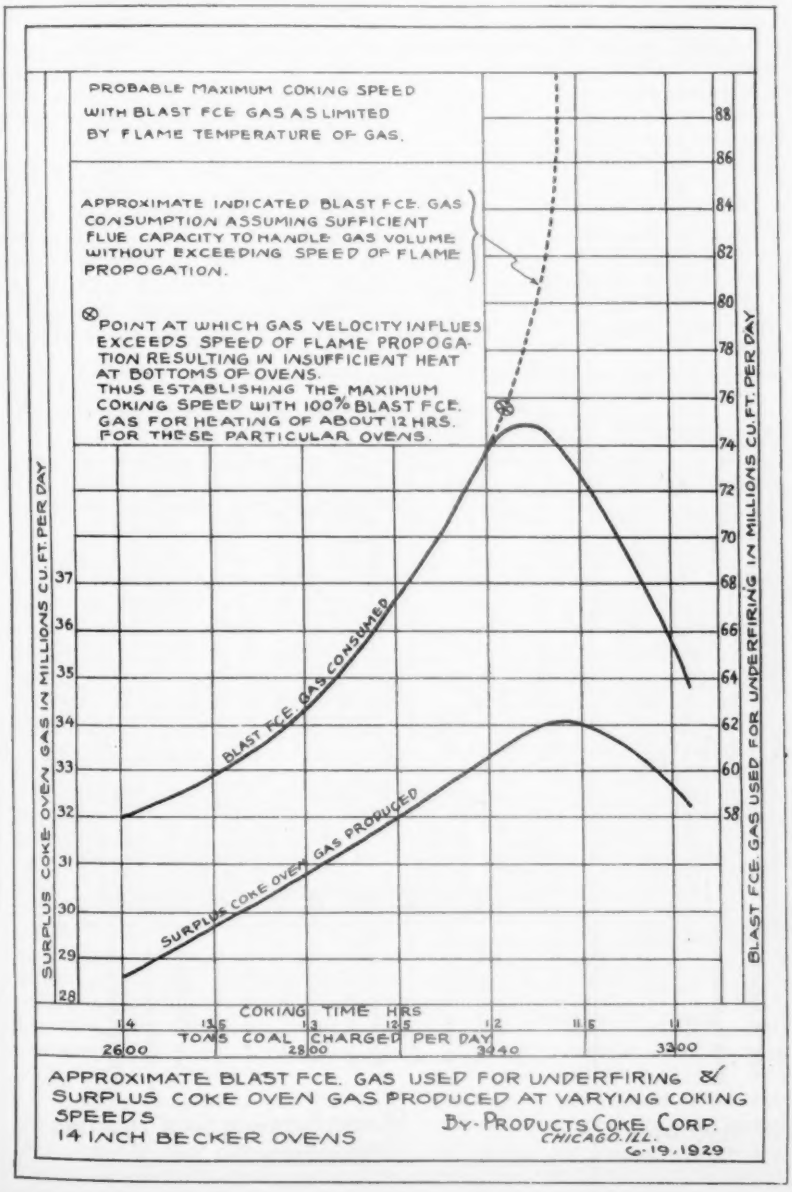
Editor's Note—This paper is presented for the interest of the many coal operators who are keenly following the utilization of coal and trends in fuel consumption. With increasing quantities of both blast furnace and coke oven gases used for underfiring these become a more important factor than ever before in estimating the probable future markets for bituminous coal.

2,800 tons of coal per day, of which 45 percent was required for the two furnace stacks. Coal gas was used for underfiring, and the surplus gas was sold for distribution as domestic gas.

The coal gas required for underfiring amounted to 10,800,000 cu. ft. of 570 B. t. u. gas per day, and the surplus furnace gas, after heating blast stoves and deducting 5 percent for leakage, amounted to 74,000,000 cu. ft. of 95 B. t. u. gas. Comparing these, the surplus energy in the furnace gas amounted to 13 percent in excess of the amount required for heating the ovens.

The purpose of the new system was, therefore, to release the valuable coal gas for sale as domestic gas, and at the same time obtain the greatest possible thermal efficiency in the use of the furnace gas. A means of raising steam in the furnace plant had to be provided, however, and this was taken care of by a new steam plant using breeze from the coke ovens.

Satisfactory utilization of furnace gas for heating ovens requires proper functioning of three sub-divisions of the process, these being the cleaning, delivery and combustion of the gas. This is especially true of our case, as the Federal Plant is located at Calumet River and 108th Street, and separated from the coke plant at Torrence Avenue and 112th Street by the Calumet River, several railroads, and other intervening property, so that well over a mile of piping is required to connect furnaces and ovens. The description of the installation and operation will therefore be grouped under the three heads, cleaning, delivery and heating.



Gas Cleaning

For cleaning the furnace gas to the degree necessary for its use in heating coke ovens, Theissen washers were chosen because their wide use in this country had definitely shown the efficiency that may be obtained and given assurance of continuous uniform operation. This is not, as yet, true of other types of washers, for which greater efficiency is claimed. Five washers, having a capacity of 13,900 cu. ft. per minute each, were installed, one a spare. They are driven by 200 hp. 2,300 volt, synchronous motors (Allis Chalmers) at 360 r. p. m. Theissen washers consist of a large hollow drum, mounted on its longer and horizontal axis, and decreasing slightly in diameter from inlet to outlet end. The drum is rotated inside of a larger shell, of the same shape, the outer surface of the drum being provided with spiral vanes, which have a slight clearance from ribs on the inner surface of the shell. The effect of the vanes is to cause the gas to travel in a long spiral course through the space between the drum and casing, the direction of rotation being such as to retard the travel of gas through the machine.

Water is introduced by gravity flow into the space between drum and casing, along the length of the machine, and is picked up by the vanes, where the clearance between vane and rib is small, and thrown violently into the space in which gas is travelling. The flow of water may be at any desired rate up to 50 gallons per minute, the power consumption being directly proportional to the amount of water used.

Clearance of the drum is such that there is very little loss in the pressure of gas passing through the scrubbing section of the machine, and by means of a built-in fan, attached to the outlet side of the drum, a positive gain in pressure of 9 in. of water is obtained, when operating at full load.

Each washer is equipped with a butterfly valve on outlet for regulation of flow, and with gate valve and water seal valve on inlet and outlet, which provides a maximum of convenience and safety in handling the machines. The water seal valves or dip pipes act as positive seals against gas leakage when machines are idle, and also as removers of water carried in suspension in the gas, when washer is in use.

Preliminary cleaning of the gas is accomplished by the usual dry dust catcher, a Roberts and Kennedy dry cleaner, and a Brassert tower scrubber on offtake of each furnace. Recovery of dry dust

amounts to 100 tons per day, and the gas entering the Theissens contains an average of 0.35 grains dust per cubic foot.

The extent to which the gas is freed of dust in the Theissens is influenced by the amount of water used, up to about 3.0 gallons per 1,000 cu. ft. of gas, and also by the rate at which gas passes through the washer. The amount of dust in the incoming gas is of much less importance.

Power consumption is nearly independent of rate of gas flow and is dependent on rate of water flow. The relationship between cleanliness and water rate or power consumption at any rate of gas flow may be established by test, and water rate thus fixed.

Gas Delivery

The 9-in. increase in gas pressure obtained at expense of some extra power for the Theissens would be sufficient to deliver the gas to a holder close at hand, but on account of the distance to the ovens, gas boosters were provided. These consist of three Ingersoll-Rand turbo-compressors (one spare), having a capacity of 24,700 cu. ft. per minute each at 2,650 r. p. m. and of 42,000 cu. ft. per minute at 4,300 r. p. m. They are direct connected to 188 hp. Terry turbines, which are now run condensing at steam pressure of 150 pounds. Washers and boosters, with the necessary electrical control, including d. c. generating set for excitation of motors, are housed in a single building, which is ventilated and heated by forced draft of clean air, and is equipped with every convenience for the comfort and safety of the operators.

The inlet and outlet of each booster is provided with gate valve and water seal valve, as are the washers, the quick sealing valves being located outside the main building, in small concrete chambers, which are also ventilated by the forced draft.

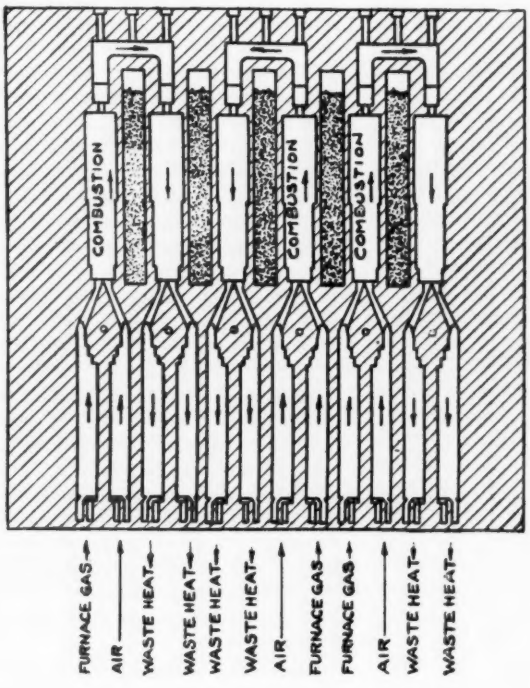
A feature of the gas handling system is the automatic pressure control valve, located between washers and boosters to guard against loss of positive pressure in the system due to temporary stoppage of blast to the furnaces. It consists of a floating drum from which a valve disc is suspended. The float is counterweighted so that a certain minimum pressure under the drum holds the valve in the raised position and allows the gas to pass. In case of decreased gas supply, the boosters can reduce the pressure only to the point where the float sinks and the suspended disc seals itself in water, shutting off delivery of gas to the boosters. As soon as the minimum pressure is restored by flow of gas from the furnaces the float rises and the flow of gas to the boosters is resumed. The float is set to close at a minimum of 5-in. pressure before the washers.

The plant is equipped with recording pressure gauges, thermometers, gas flow meter, and distance type recorder, showing amount of gas in the holder at all times. A system of buzzer and telephone communication with furnaces and ovens is provided.

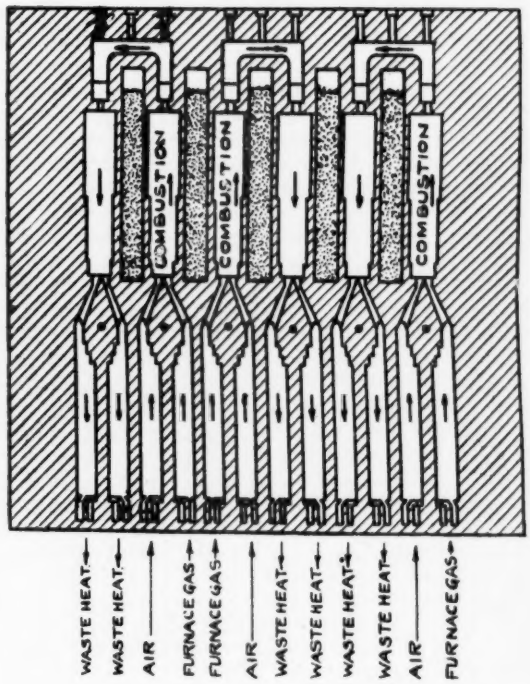
Delivery of the gas to the ovens is through about 5,000 ft. of 60-in. riveted steel pipe, including that laid in a tunnel under the Calumet River. About 400 ft. of cast iron pipe is laid under railroad tracks and streets, the remainder of the travel being above ground.

Washing and delivery of the gas to the holder is taken care of by three men per shift, the operator and helper, and the booster engineer. The duties of operator are inspection of washers, motors, gauges, quick-sealing valves, and drains, and regulation of flow of water to washers. The helper oils and greases, keeps building clean, and operates drip pump at tunnel. Booster engineer cares for turbines, and sees that holder is kept full of gas. If excess gas is being made, it is diverted to one of the boilers, which is equipped for burning gas as well as breeze.

At the coke plant the gas is received in a 2,000,000 cu. ft. waterless holder, having a working pressure of slightly more than 11 in. of water. Its purpose is to supply gas for a limited time in case of interruption of delivery from furnaces, and especially to provide a constant pressure in the mains leading to



BLAST FURNACE GAS HEATING.



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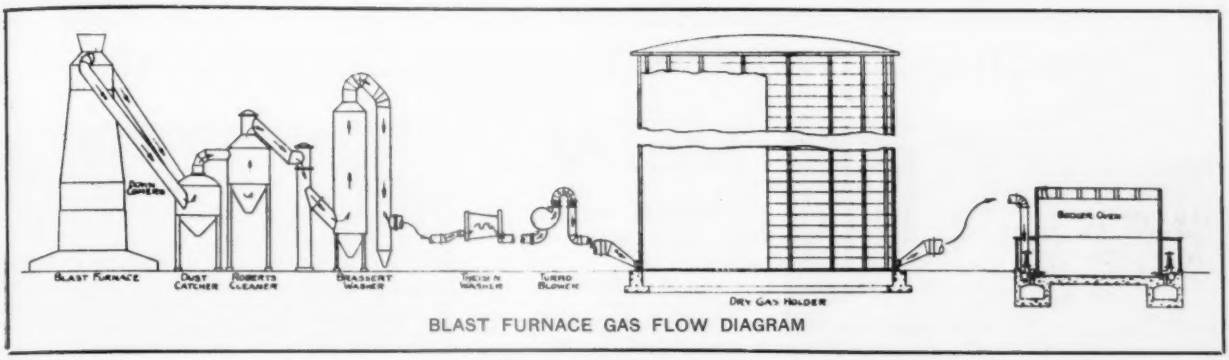


BLAST FURNACE GAS FLOW DIAGRAM

the regenerators. The holder is provided with elevator and a tar conditioner. In addition to these, for safety of operation an automatic control is provided, which begins to close a butterfly valve on holder outlet in case the piston descends to a minimum level, sounding sirens and successively shutting off gas to each of the batteries by means of the reversing machinery. The valve is actuated by counterweights, which also control the piston level indicator on outside of holder. A Republic type of distance recorder is installed, which records in the foreman's office at batteries, and in washer building, the height of piston at all times. Care of the holder, which is in charge of the heaters, consists of inspection of piston, of tar pumps and tar conditioner, which is in continuous operation.

Gas is piped to both ends of each battery, and there divided between coke and pusher sides. The fuel mains are buried in dry sand in front of regenerators just above the waste heat flues, so that the gas is preheated as much as possible. (Preheat equals about 40 degrees F.)

On outlet of holder an automatic gas enriching device is provided through which sufficient coal gas, to maintain any desired constant B. t. u. in the fuel gas, may be mixed with the furnace gas. Further along the line is a Thomas recording calorimeter and gas flow meters to record the amount of gas to each battery.

Cleanliness of the Gas

Many tests have been made of the amount of dust in the gas at different points in the system, the amount in the gas entering the regenerators, and what becomes of it, being of most interest. The amount of true furnace dust after the gas holder has averaged about 0.013 grains per cubic foot; and tests of the waste gas going to the oven stack has shown an equivalent amount of ash being carried out with the waste gas. No accumulation of dust in the regenerators or flues has been detected.

Due to the charging of oily borings to the furnaces, it has been found that there is carried in the gas a considerable amount of oil, in suspension or in combination with the dust particles. The percentage of oil in samples of oil and dust collected by the usual Brady method of dust testing varies all the way from 20 percent to 70 percent of the total weight. The amount of true furnace dust in a sample is determined by extracting with benzol and drying in the usual way, as in testing oils for solids. Tests have also been made which show that there is very little of this oil present in the true vapor state.

It has been found that some dust is removed in the holder, of the order of 0.002 grain per cubic foot, most of which is contained in the condensed water. There is also a loss of an equal amount in the passage through the piping from boosters to holder, this being found in the water from the drips. Due to the washers and boosters being so closely connected, no tests have been made on the gas immediately after the washers, but rather are made after the boosters. The latter are operated with water sprays, and tests of the small amount of drippage shows that very little dust is removed in them. It is therefore necessary for us to clean the gas to about 0.018 grains per cubic foot in the washers.

The volume of gas cleaned per day has averaged over 70,000,000 cu. ft., of which about 6,000,000 cu. ft. is used to dilute coal gas for underfiring some old Solvay ovens, thus releasing an equivalent amount of coal gas.

A typical analysis of the oil-freed dust, collected after the holder, may be of interest:

	Percent
SiO_2	19.5
Fe_2O_3	6.6
Al_2O_3	16.7
CaO	12.8
MgO	2.7
Carbonates as CO_2	7.1
Carbonaceous as C	3.5
Soluble Na as Na_2O	6.3

Heating of Ovens

The arrangement of reversing machinery and of flow of fuel gas, air and waste gas is the same as when heating Becker ovens with producer gas. On each side of the battery the fuel gas for two walls passes up through two adjacent regenerators while the air for combustion passes up through two regenerators to the right and left of the gas. The waste gases from the two walls pass over above their respective ovens, descend the off walls, and pass out through two pairs of regenerators adjacent to the incoming air. Four walls with their eight regenerators form a unit, in which the reversing machinery reverses the flow of gas every half hour.

The original coal gas heating equipment is retained, and may be resorted to in a few minutes time, in case of need. The only change made in the alleys was substitution of the combination fuel gas and waste gas boxes, which were required on one-half of the regenerators. The ovens, which were erected in 1924, were designed to be heated with coal gas, producer gas, or furnace gas, and no structural changes were necessary in changing from oven to furnace gas.

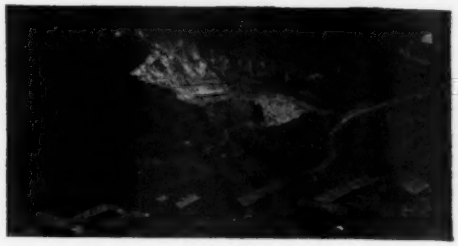
These ovens, coking 13.8 tons of coal per charge, are 13 ft. high, 40 ft. 8½ in. long and taper from 13¼ in. to 14¾ in. in width. The designed coking time was 13 hours, using oven gas. Coking time with oven gas heating has varied from 11 to 13 hours, pushing coke at 1,775 degrees F. In changing over to furnace gas, the coking time was temporarily slowed from 11.0 to 14 hours, and then immediately reduced to 12.9 hours gross. At this point it was found that the limit of stack capacity had been reached for winter conditions and in order to maintain this rate in summer, or further decrease the coking time, additional stack draft would be required.

This was provided by the installation of waste gas fans having a capacity of 120,000 cu. ft. per minute at 560 r. p. m. These fans increased the stack draft from a maximum of 30 to 45 mm. of water. We were then able to reduce the coking time to 12 hours on straight blast furnace gas of 95 to 100 B. t. u. Here it was found that the speed of the gases in the flues approached the speed of flame propagation for this gas. A further increase in speed and volume of gas through the system drew the flame up in the flues, resulting in insufficient heat at the (*Continued on page* 192)

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry



Recent Changes in Mining Methods at RAY MINES of the NEVADA CONSOLIDATED COPPER CO.

By C. A. KUMKE *

Efficiency of men, elimination of timber repairs and improved ore extraction achieved—Pyramidal undercutting system devised—Uniform ore drawing essential—One hundred per-cent extraction maintained—Graphic illustrations and costs

IT IS the purpose of this paper to outline the changes made in the mining methods at the Ray Mines of the Nevada Consolidated Copper Company since the last meeting of the Chapter at Ray on March 8 and 9, 1926. At the time of the last meeting, mining operations were confined to two methods, viz., the standard motor method and the hand tramming method. The original stope and pillar method had been replaced by undercutting methods in the softer ground and in connection with the undercutting method the blocks were being completely cut off on the side by shrinkage stopes carried up to capping around the outer limits of the block.

A desire for improvement in costs is the main factor calling for alterations or changes in mining methods, and the following three essentials are to be considered in any change in mining methods where tonnages are obtained by the caving method: *first*, the new method must be such as to improve the efficiency of the men working on the production of ore; *second*, it must eliminate as much as possible repairs to timbers which interfere with the efficiency of the men and also the efficiency of the haulage system; *third*, the new method should improve the percentage of extraction of the ore by a more advantageous spacing of the draw points.

Since the last meeting of the Chapter at Ray, two new methods have been developed, one designated as the modified motor method, which is used where the heights of ore are small, and the other the sublevel system, where at least 90 ft. of ore is available for drawing above the sill on the grizzly drifts on the sublevel. These two methods have improved the efficiency of the men, have reduced the amount of repair work required, have decreased the weight on the haulage laterals allowing for a more uniform production from each block, and hence have improved the cost materially. Sufficient sections have not yet been drawn to completion to give definite data as to what might be expected from a cost standpoint for these two new methods. One sublevel block which has been completed, where the height of ore was approximately 300 ft., was drawn at a cost of 16½ cents per ton, including the carrying up of the cut off stopes around the fringes of the block as well as all undercutting operations. Another completed sublevel block in an area where the ore averaged approximately 100 ft. in height showed a cost of 21 cents, while the modified motor system indicates a cost of approximately 27 cents per ton for the same operation, as compared with an average cost of 31 cents per ton for the same work when tonnages were mined by the old motor system. There has also been a marked improvement in the extraction of ores, particularly in the softer ground, where the spacing of draw points afforded by the sublevel system and the modified motor system is a marked improvement over the old motor method.

The above costs are f. o. b. mine cars and include only stoping, undercutting and drawing, and do not include the cost of haulage and hoisting, miscellaneous mine expense and other overhead charges, as well as the cost of preparing the blocks for mining.

The following discussion covering these two methods is reprinted in part from the U. S. Bureau of Mines Information Circular No. 6167.

MODIFIED MOTOR METHOD

The modified motor method has the advantage of keeping some of the weight off of the motor-haulage laterals and thus minimizes delays and interruptions in train service. It also allows a closer spacing of the draw points, which is essential in softer ground.

The details of the modified motor method are outlined in *figure* 1. Laterals are spaced 40 ft. apart, and the panels are four drifts or 160 ft. wide. The length of the block is usually 130 ft. The increased length of the block is permissible because less timber repairing is required in the laterals. Pony sets are put in over the laterals for the entire length of the block, and chutes are placed in the pony sets at 15-ft. intervals. Chutes are staggered, so that those on

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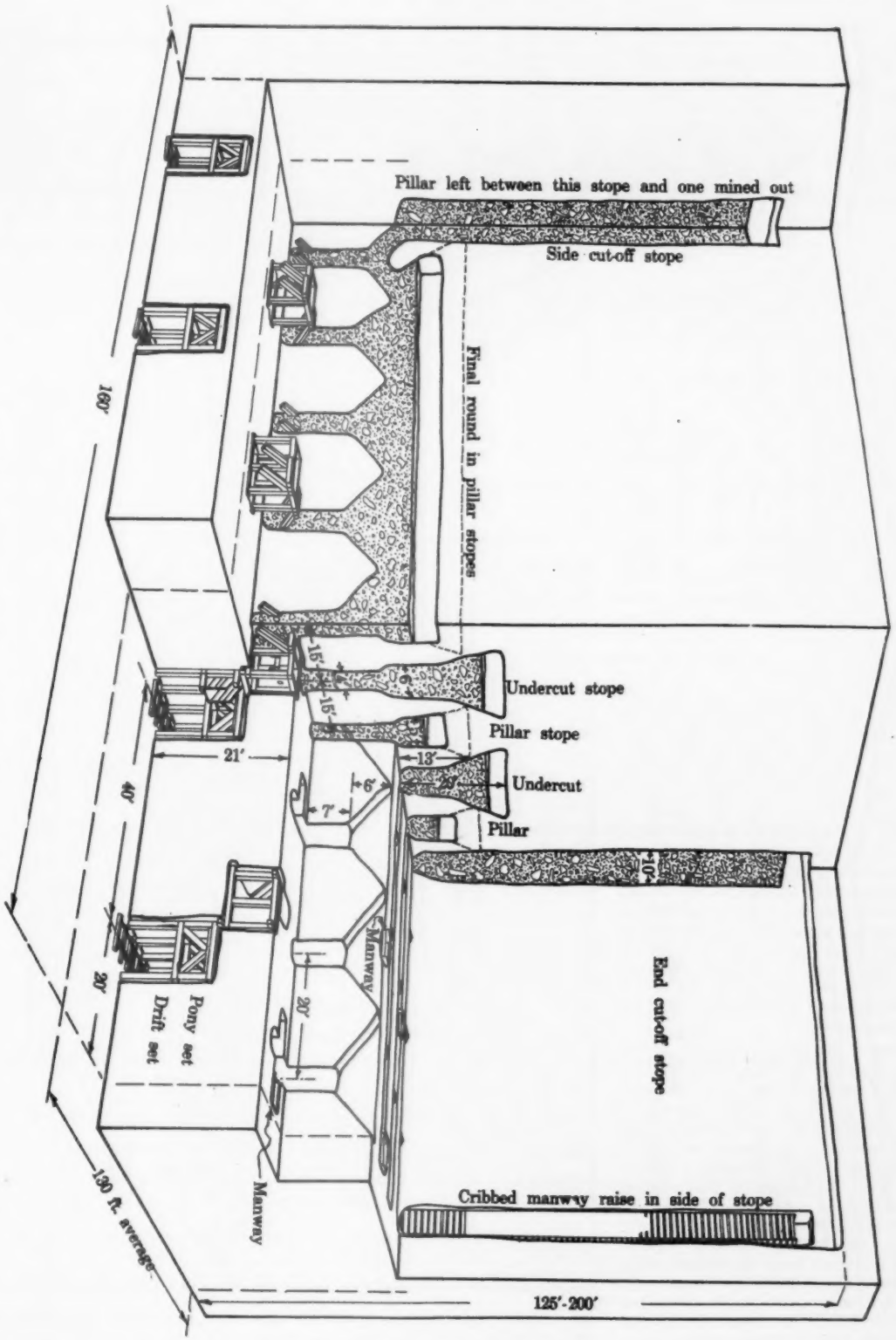


FIGURE 1. MODIFIED MOTOR-HAULAGE CAVING METHOD.

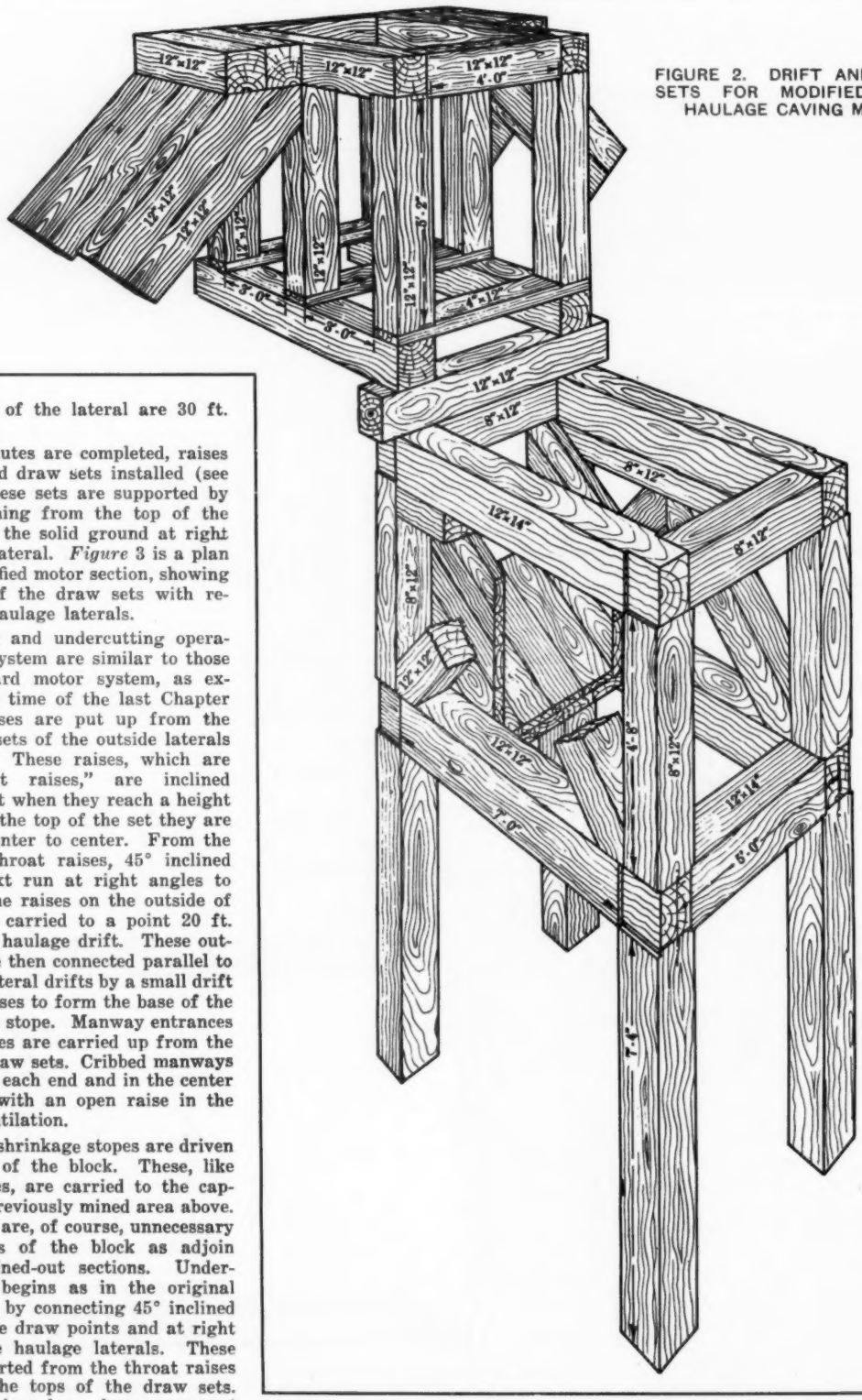


FIGURE 2. DRIFT AND THROAT SETS FOR MODIFIED MOTOR-HAULAGE CAVING METHOD.

the same side of the lateral are 30 ft. apart.

After the chutes are completed, raises are started and draw sets installed (see *figure* 2). These sets are supported by stringers running from the top of the pony cap into the solid ground at right angles to the lateral. *Figure* 3 is a plan of such a modified motor section, showing the location of the draw sets with respect to the haulage laterals.

The stoping and undercutting operations in this system are similar to those of the standard motor system, as explained at the time of the last Chapter meeting. Raises are put up from the outside draw sets of the outside laterals of the block. These raises, which are called "throat raises," are inclined slightly so that when they reach a height of 7 ft. above the top of the set they are 15 ft. from center to center. From the tops of the throat raises, 45° inclined raises are next run at right angles to the lateral; the raises on the outside of the block are carried to a point 20 ft. outside of the haulage drift. These outside raises are then connected parallel to the haulage lateral drifts by a small drift or inclined raises to form the base of the side shrinkage stope. Manway entrances for these stopes are carried up from the ends of the draw sets. Cribbed manways are carried in each end and in the center of the stope with an open raise in the center for ventilation.

End cut-off shrinkage stopes are driven at both ends of the block. These, like the side stopes, are carried to the capping or to a previously mined area above. Cut-off stopes are, of course, unnecessary on such sides of the block as adjoin previously mined-out sections. Undercutting then begins as in the original motor method by connecting 45° inclined raises over the draw points and at right angles to the haulage laterals. These raises are started from the throat raises 7 ft. above the tops of the draw sets. When the raises have been connected across the width of the block, the ground left between the diverging raises above the throat raises is blasted down to give a slot 4 ft. wide with a level back from one end to the other, after which shrinkage stoping commences. The width of the stope is then increased to 6 ft. for two or three rounds and then again increased so that the final round will break a width of at least 18 ft. at a height of 40 ft. above the top of the pony caps. Cribbed manways are put up at the ends and sometimes in the center of each undercut stope, starting from the ends of the throat sets. Five feet of solid ground is usually left unbroken between the ends of these transverse stopes and caved ground in an adjoining panel.

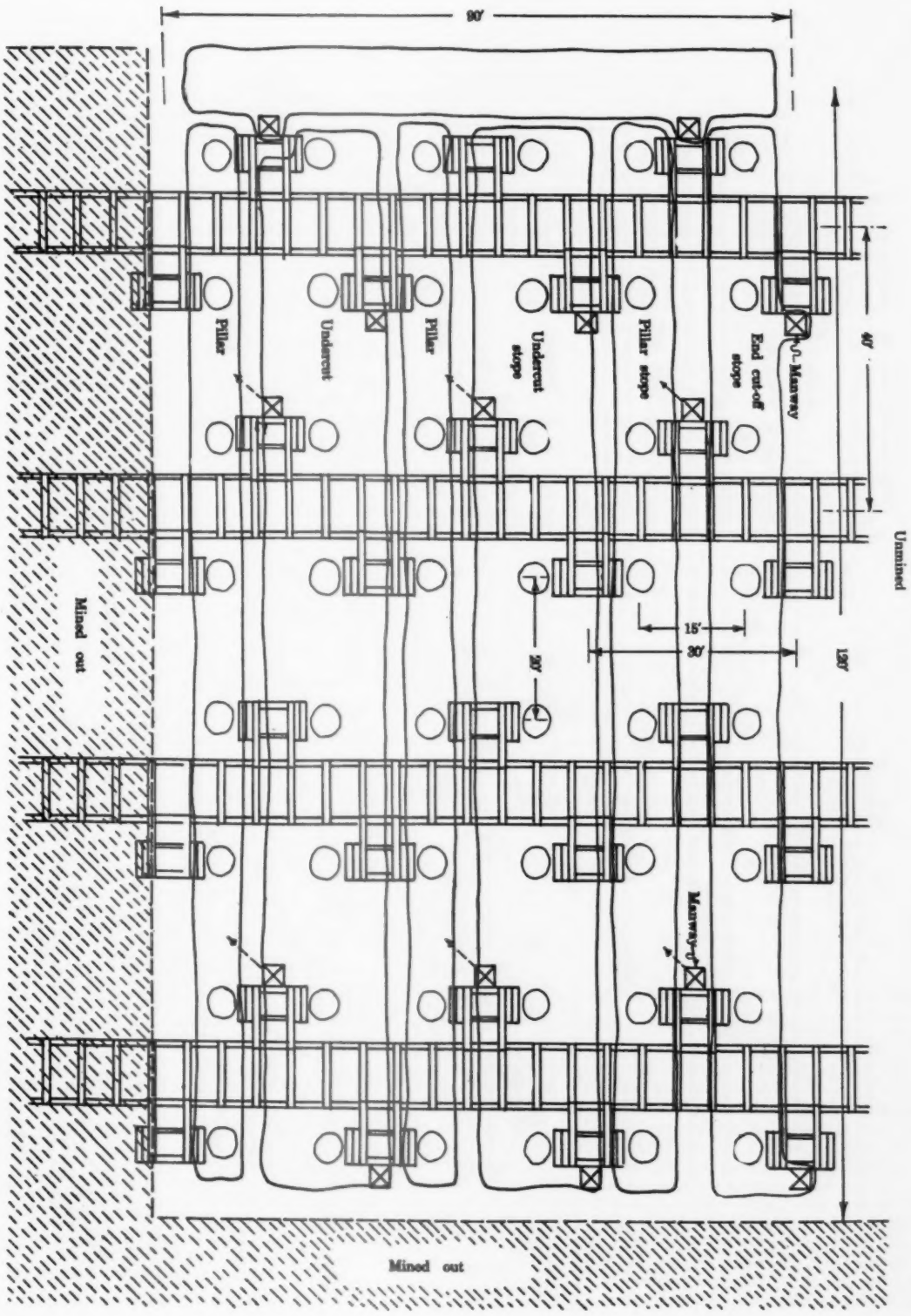


FIGURE 3. PLAN SHOWING SPACING OF DRIFTS, THROAT SETS, RAISES, AND STOPES IN MODIFIED MOTOR HAULAGE CAVING METHOD.

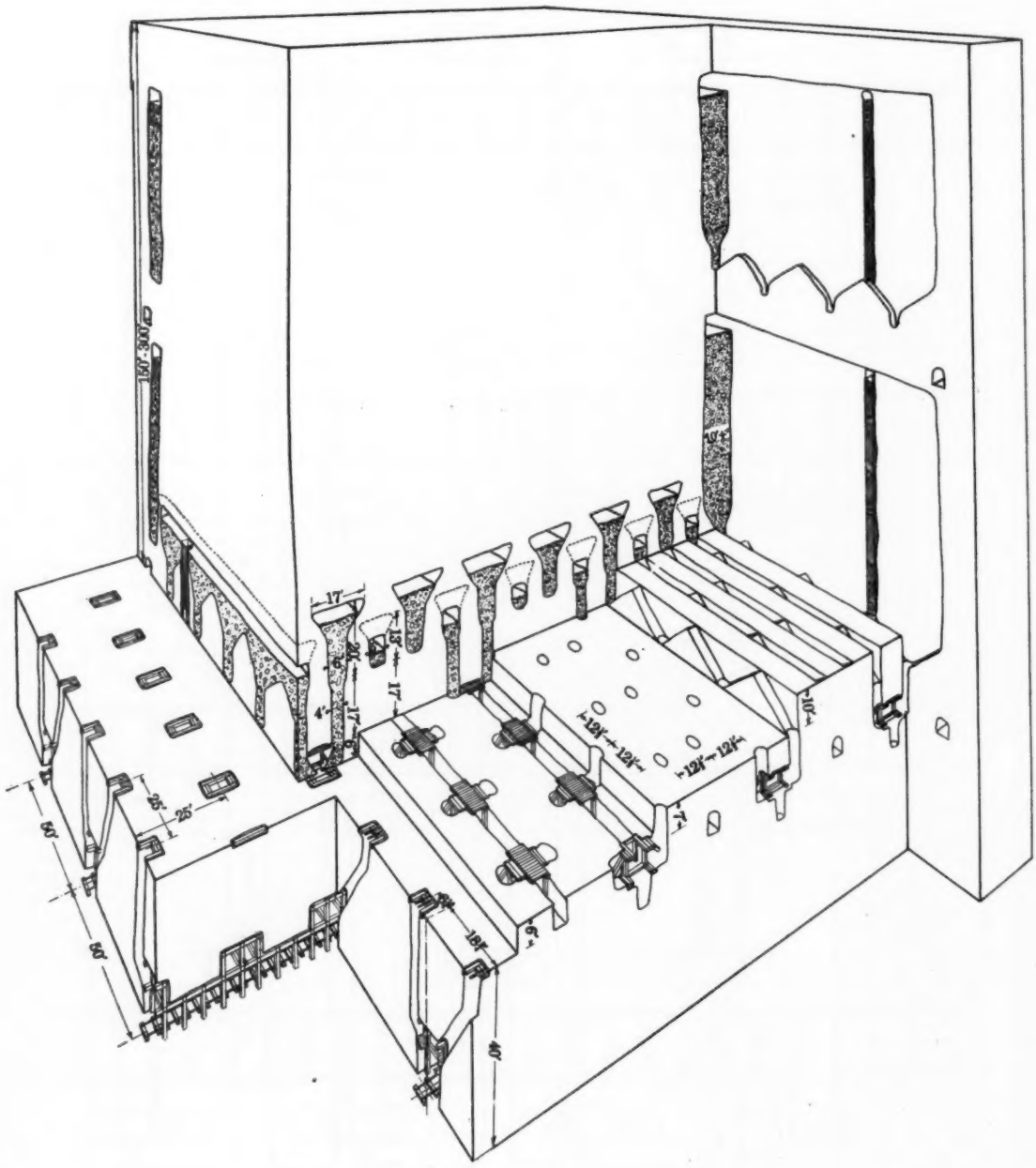


FIGURE 4. SUBLEVEL UNDERCUT CAVING METHOD

This prevents running in of waste rock. It necessitates, however, careful mapping and plotting of all stopes.

Similar but smaller stopes are next driven in the pillars between the undercut stopes. They are started in similar manner by connecting inclined raises, but are carried only 5 ft. wide and just one round above the tops of the cones; then a final round, which brings them to a height of about 32 ft. above the top of the pony caps, is fanned out in such a manner as to break into the undercut stopes on both sides. Both undercut stopes and pillar stopes connect with their final round with the side cut-off stope at either end. From this point on, regular drawing procedure is followed.

Sublevel Method

The sublevel method is used in all kinds of ground where the ore extends 150 ft. or more above the haulage level. It is the most satisfactory of the various methods employed at Ray.

No weight has as yet been experienced in the motor-haulage laterals, and after drawing operations are completed in any area the timbers used in the haulage drifts can be reclaimed and used in the development of another block. In some instances so little weight is encountered on the grizzly, or sublevel, that it is possible to reclaim some of this timber also.

Although the spacing of the chutes is not as regular as in the case of the modified motor system, they are so arranged as to prevent the formation of ridges of undrawn ore. The method of undercutting the block is almost identical with that pursued in the modified motor method, but the position of the drawing chutes and of the grizzly drifts is such that they receive the protection of the cones, or pyramids, of solid rock that are developed in the undercutting procedure. This results in providing for the working places a maximum of protection from the weight of the caving ground with a consequent minimum of expense for maintenance and repairs. A panel 200 ft. wide is usually developed by four motor-haulage drifts at 50-ft. centers (see *figure* 4). Pony sets are installed over every fourth and fifth drift set. One of these has a chute on both sides of the drift, the other is for the convenience and safety of the loader on the motor-haulage level. Raises 4 ft. in diameter are driven from these chutes to a height of 40 ft. above the rail. The raises are inclined in such a manner as to connect with the sublevel draw laterals at 25-ft. centers, and these connections are staggered in alternate sublevel laterals as shown in *figures* 4 and 4*A*.

As soon as this work has progressed far enough to give the required connections to the sublevel, the development of the sublevel is started, this level consists of small timbered fringe drifts on the boundaries of the stoping block and small untimbered drifts or "laterals" across each line of raises from the haulage level. These sublevel laterals are 25 ft. center to center and at right angles to the haulage drifts. Over the top of each storage raise a grizzly set with bars 13 in. apart is installed (see *figure 5*). After development work has been completed, the undercutting of the block proceeds as in the modified motor method just described. Due to the greater height of the ore, the cut-off stopes, as indicated in *figure 4*, are generally mined in two lifts, the upper section of the cut-off stopes being carried up first from an upper level and the shrinkage muck hand-trammed to transfer raises.

Cribbed stope manways, as previously explained, are put up at the ends and in the middle of the stopes. In the long manways for cut-off stopes, the cribbing is 3 by 6-in. timber and the manway 2½ ft. square inside. In the undercut stopes the cribbing is 2 by 6-in. material and the manway 2 ft., 8 in. in the clear. The use of the lighter material in the manways for the undercut stopes is made possible by their temporary nature and the small height to which they are carried.

In the modified motor method the drawing operations are conducted on practically the same basis as in the motor section, the chute blaster drawing directly from the chute into the motor-haulage cars. In case the chute hangs up, it is necessary for him to enter the draw set and blast it down.

In the sublevel method drawing is carried on by men designated as tappers to distinguish them from the chute blasters mentioned above. The ore is drawn from the draw sets and allowed to run directly into the storage raises. As in the other drawing operations it is often necessary to blast; and if the muck is hung up any distance from the draw point, this is done with blasting sticks, the tappers being forbidden to enter the chutes. Most of this blasting is done with fuse and cap; however, when chutes are hung up in such a manner as to require time and care to place the charge in the correct position, electric blasting caps are used. Thirty percent dynamite is used in blasting chutes. No blasting is permitted on the grizzlies, hammers being used to break such boulders as are too large to pass. In order to prevent accidents to the men drawing the storage raises on the haulage level, an electric signal system is used to give warning of blasting to be done on the sublevel.

The method of undercutting used at Ray has been adopted for two reasons. *First*, to provide pyramids or cones of solid rock above the drawing level which tend to support the broken ground and keep the direct weight from coming upon the draw sets or upon the drawing level. *Second*, this method of undercutting breaks approximately 45 ft. of ground over the draw point. This considerable thickness of broken ore not only acts as a cushion, but as it is drawn off, allows more thorough breaking up of the main mass of ore before the latter reaches the draw points.

A uniform draw, particularly during the early stages of drawing, is essential for satisfactory recovery. If the early

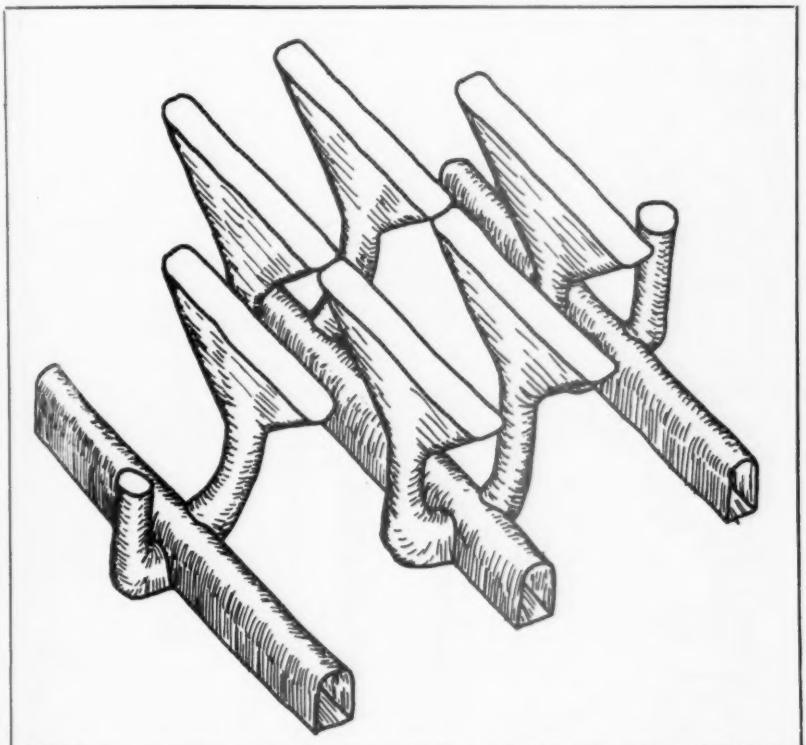


FIGURE 4A. THROAT RAISES AND SLOTS FROM SUBLEVEL DRAW LATERALS UP TO BASE OF UNDERCUTTING STOPES. NOTE LARGE AMOUNT OF SOLID ROCK LEFT AS PROTECTION FOR LATERALS.

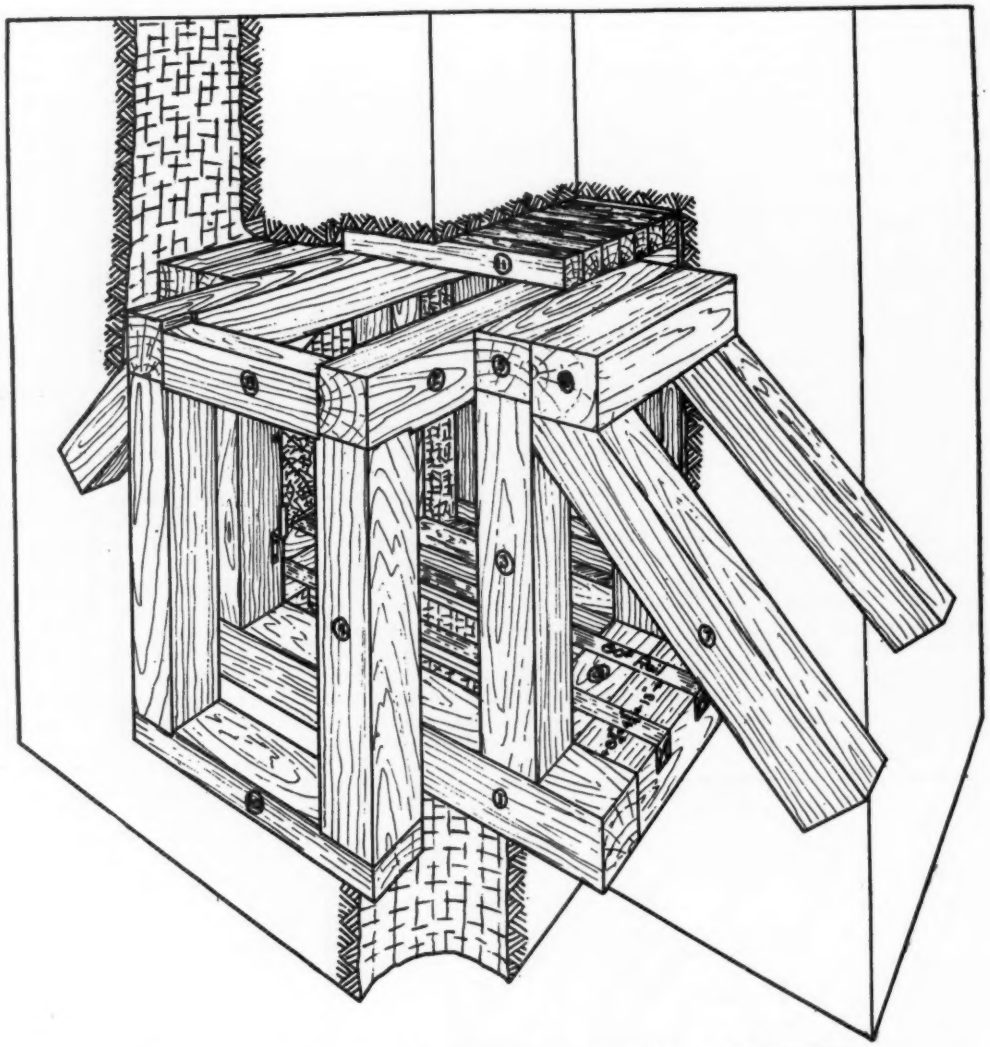


FIGURE 5. THROAT SET AND GRIZZLY FOR SUBLEVEL CAVING METHOD.

Bill of Material

No.	Pieces	Name	Size	Bd. ft.
1	2	Stringers	12″ x 12″ x 9′ 0″	216
2	2	Caps	12″ x 12″ x 10′ 0″	240
3	4	Posts	12″ x 12″ x 5′ 3″	252
4	4	Posts	12″ x 12″ x 5′ 3″	252
5	2	Caps	10″ x 12″ x 5′ 4″	106
6	2	Caps	12″ x 12″ x 5′ 4″	128
7	4	Posts	12″ x 12″ x 5′ 4″	240
8	2	Collar Braces	8″ x 10″ x 3′ 2″	42
9	4	Spreaders	12″ x 12″ x 3′ 4″	160
10	2	Sills	6″ x 12″ x 5′ 0″	60
11	15	Lagging	6″ x 8″ x 5′ 0″	300
			Total	1996

drawing is not done uniformly, the mass of ore may cave along some unknown plane of weakness, causing chimneys or cavities which may extend into the capping and allow it to mix with the ore. After the main mass of ore has been thoroughly broken and the block has caved to the surface, the result of subsequent irregular drawing is not as serious as would have been the case earlier. However it is thought best to maintain uniform drawing at all times.

Individual blocks are drawn separately, as each block is cut off on all sides by cut-off stopes. Undercutting operations are carried on progressively from one end of the block to the other, and are immediately followed by drawing operations on a limited scale. This gradually removes the support from under the main mass of ore, and by setting up a cantilever action, causes it to slough and break up. As soon as the block is completely undercut the regular procedure of uniform drawing is started through the block. The same procedure is followed in the next block of the panel, undercutting and drawing being started at the end remote from the previously mined block.

The following tabulation shows the production of ore by each of the various mining methods and by preparatory excavation during the year 1928:

	Tons	Percent Total
Preparatory excavation	186,742	5.76
Hand-tramming method	119,981	3.70
Regular motor method.....	388,154	11.97
Modified motor method.....	294,769	9.09
Sublevel method	2,253,513	69.48
Total mine production....	3,243,159	100.00

The following tabulation is a summary of costs for the year 1928:

SUMMARY OF COSTS, YEAR 1928

	Labor	Timber	Explosives	Power	Machine shop	Misc.	Total
Preparatory excavation.....	$0.0581	$0.0339	$0.0070	$0.0014	$0.0010	$0.0022	$0.1036
Stoping	.0711	.0082	.0247	.0050	.0016	.0059	.1165
Reserve drawing	.0940	.0129	.0190	.0001	.0001	.0006	.1267
Haulage (including operation tipples)	.0585	.0006	.....	.0078	.0139	.0101	.0909
Hoisting	.0084	.0301	.....	.0071	.0014	.0027	.0197
Misc. mine expense	.0368	.0001	.....	.0114	.0016	.0074	.0573
Plant administration and general	.0445	.0005	.....	.0023	.0018	.0602	.1093
General overhead (exclusive of taxes)	.....	.....	.....	.....	.....	.0526	.0526
Totals	0.3714	0.0563	0.0507	0.0351	0.0214	0.1417	0.6766

The tabulation below shows the estimated cost of preparatory work for a block containing 560,000 *tons.*

ESTIMATED COST OF PREPARATORY WORK FOR A BLOCK CONTAINING 560,000 TONS,* RAY MINES, NEVADA CONSOLIDATED COPPER CO.

	Tons	Shifts	Units	Cost per unit				Total cost, labor, timber and explosives	
				Labor	Timber	Explosive	Total	Amount	Cost per ton †
Supply drifts	1,625	377	325 ft.	$3.94	$1.93	$0.74	$6.61	2,148.25	.....
Grizzly drifts	4,805	674	1,456 ft.	1.88	.....	0.66	2.54	3,698.24	.....
	1,310	784	56 ft.	82.00	81.83	4.52	168.35	9,427.60	.....
Totals.....	7,740	1,835	1,781 ft.	.....	.....	.....	.....	15,274.09	$0.027
Shrinkage stopes ‡									
Undercutting ‡	16,240	4,236	16,240 tons	0.63	0.11	0.32	1.06	29,124.56	.....
Grizzlies	11,236		11,236 tons						
Totals.....	27,476	4,236	27,475 tons	.....	.....	.....	.....	29,124.56	.052
Total above grizzy level.....	35,216	6,071	.....	.....	.....	.....	.....	44,398.65	.079
Haulage drifts	6,090	333	700 ft.	6.53	4.37	0.95	11.85	8,295.00	.....
Pony sets and chutes.....	2,800	130	560 ft.	3.85	3.82	0.22	7.89	4,418.40	.....
Haulage raises	5,544	326	1,848 ft.	.91	.....	0.65	1.56	2,882.88	.....
Total below grizzly level	14,434	1,289	3,108 ft.	.....	.....	.....	.....	15,596.28	.028
Total development exclusively of shrinks and undercuts	22,174	3,124	.....	.....	.....	.....	.....	30,870.	.055
Grand total	49,650	7,360	.....	.....	.....	.....	.....	59,994.93	.107

* Area=35,000 square feet; lift, 200 feet. † Costs per ton are based on 560,000 tons production. ‡ Tonnage used is swell only.

ESTIMATED COST OF PREPARATORY WORK FOR A BLOCK CONTAINING 560,000 TONS,* RAY MINES, NEVADA CONSOLIDATED COPPER CO. —(Continued)

	Haulage and hoisting		Assaying ventilation and sampling		Machine drills		Miscellaneous mine expenses		Grand total	
	Amount	Cost per ton†	Amount	Cost per ton†	Amount	Cost per ton†	Amount	Cost per ton†	Amount	Cost per ton†
Supply drifts	167.37	.....	37.38	.....	287.27	.....	55.25	.....	.....	.....
Grizzly drifts	494.92	.....	110.52	.....	849.43	.....	163.37	.....	.....	.....
Grizzlies	134.95	.....	30.12	.....	231.60	.....	44.54	.....	.....	.....
Totals	797.24	.001	178.02	.0003	1,368.30	.0024	263.16	.0005	17,880.81	.0312
Shrinkage stopes*	2,830.01	.....	631.95	.....	10,080.00	.....	934.18	.....	.....	.....
Undercutting*										
Totals	2,830.01	.005	631.95	.0011	10,080.00	.018	934.18	.0016	43,600.70	.0777
Total above grizzly level.....	3,627.25	.006	809.97	.0014	11,448.30	.0204	1,197.34	.0021	61,481.51	.1089
Haulage drifts	627.27	.....	140.07	.....	1,076.65	.....	207.06	.....	.....	.....
Pony sets and chutes.....	288.40	.....	64.40	.....	494.98	.....	95.20	.....	.....	.....
Haulage raises	571.03	.....	127.51	.....	980.07	.....	188.50	.....	.....	.....
Total below grizzly level.....	1,486.70	.003	331.98	.0006	2,551.70	.0046	490.76	.0009	20,457.42	.0371
Total development exclusive of shrinks and undercuts....	2,283.94	.004	510.00	.0009	3,920.00	.007	753.92	.0014	38,338.23	.0683
Grand total	5,113.95	.009	1,141.95	.002	14,000.00	.025	1,688.10	.003	81,988.93	.146

* Costs per ton are based on 560,000 tons production. † Tonnage used is swell only.

The adjustable pneumatic brattice being carried by two men

By V. T. BERNER *

Adjustable Pneumatic BRATTICE

New method which eliminates heavy manual labor and saves many hours—Light weight, quick adjustment, adaptability, strength and long life claimed for equipment—Simplicity of installation by two men makes for quick service

SOME four years ago the thought occurred to the writer that the brattice equipment used by mine rescue crews was inadequate for efficiently combating mine fires.

During recent years many advances have been made in self contained breathing apparatus, life lines, underground telephone communication, and gas detectors, but nothing has been offered as an improvement on the old stull and canvas brattice now in general use.

Since the fighting of underground fires depends on ventilation control and isolation of the fire zone, it is very essential that an efficient brattice or stopping be used which can be erected in much less time and with much less effort than the old stull and canvas brattice which is now in general use.

Rescue crews, handicapped as they are, wearing self contained breathing apparatus in dense smoke, should not be required to perform any work that can possibly be eliminated. The building of the common stull and canvas brattice necessitates considerable sawing, chopping, and hammering, which not only requires the expenditure of much energy, but also subjects the worker and the other members of his crew to possible injury, and requires anywhere from 45 minutes to an hour for its proper installation.

The difficulty of stopping the leaks around the edge of the common stull brattice first gave the writer the idea that a partially inflated rubber tube incased in the edge of the canvas and held securely against the walls by the radiating strips would mould itself to the irregularities of the walls and exert a pressure upon them. Experiments proved that the idea was sound and that by attaching a felt pad to the outer surface of the casing where it comes in contact with the wall all of the leakage was stopped. The pad also served to protect the tube from puncture.

The remaining structure, which was necessary to hold the curtain firmly in place, was merely a mechanical problem. An adjustable standard, which replaced the wedged stull, was made by a telescoped arrangement of two square sections of light Shelby steel tubing, one sliding within the other. A pin was provided which could be placed in any one of a series of holes through the inner and outer sections, and a screw jack at the base served to tighten the standard in position. This main standard combines the principles of the ordinary surveyor's sliding level rod and the miner's vertical drill column. Round maple rods, ⅝ in. in diameter and varying in lengths, after being attached to the standard at various necessary positions, hold the edges of the curtain in which the tube is encased tightly against the rock. A small high pressure oxygen bottle, fitted with an ordinary automobile pump connection, may be used to inflate the rubber tube.

The adjustable pneumatic brattice has the following features:

(1) The entire brattice packed in a convenient canvas container weighs but 60 pounds and can be carried easily by two men.

(2) Under ordinary conditions it can be erected by two men in 15 to 18 minutes.

(3) Seventy-five to 90 percent of the air current is cut off in the first 6 to 8 minutes.

(4) It can be placed in any irregular opening within the limit specified for that particular size of brattice.

(5) It is evident that the possibility of injury to the crew is practically eliminated since it is unnecessary to use the axe, hammer or saw.

(6) The brattice will withstand an enormous pressure due to the combined rigidity of the standard which is jacked into place and the numerous strips at various points along the perifery of the curtain. The encased rubber tube in the edge of the curtain, when inflated, exerts a pressure against the wall, which also assists in keeping the brattice tightly in position.

(7) Men familiar with the erection of this brattice can place it in position where the smoke is so dense that it is impossible to see, even with the use of smoke proof goggles.

* Surface foreman, Arizona Division, Ray Mines, Nevada Consolidated Copper Company.

(8) After the brattice has been carried to the place where it is to be put up its erection is merely a matter of manipulation rather than work.

(9) The brattice may be used a number of times over a period of many years. The perishable parts can be cheaply and easily replaced.

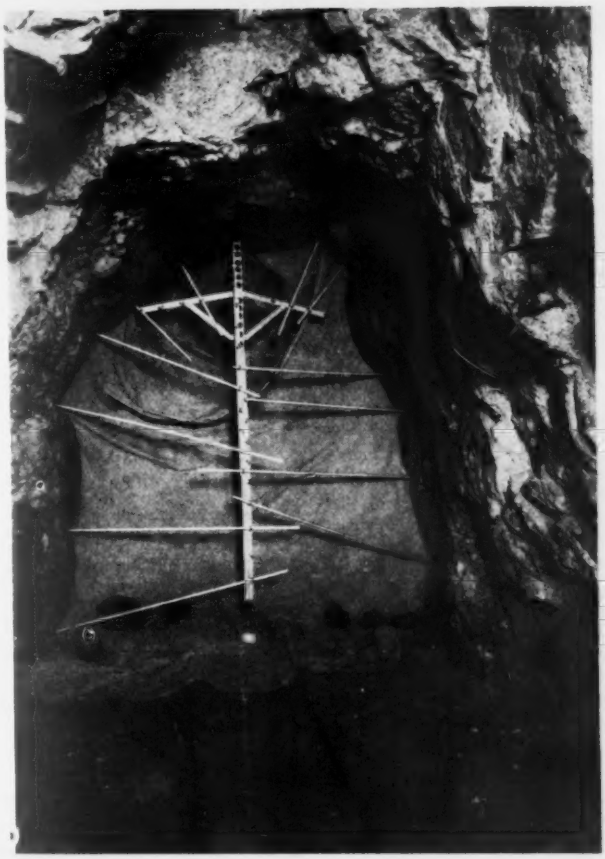
(10) The brattices if stored at various points may be used by miners to quickly isolate fires and also may afford imperiled men protection until rescue is effected.

In conclusion, the brattice is positive and cuts off completely the ventilation, which, in the main, is not true with the old style stull and canvas brattice. The ease and quickness of its installation allows rescue crews to do at least four times the amount of work that they were able to do with the old brattice; that is, with this equipment one crew could install three or four brattices at various places while they were installing one by the old method. The installation of the brattice by only two men of the crew leaves the remainder of the crew fresh and ready for any emergency. The simplicity with which it can be installed makes it a very effective brattice for use by men other than those on the helmet crew, and the brattice being complete as a unit eliminates the necessity of the men, who may be caught in isolated portions of the mine during a mine fire, searching for brattice material.

Figure 2. (Left above) Erecting brattice — elapsed time three minutes.

Figure 3 (Right above) Elapsed time six minutes.

Figure 4 (Right) Completed brattice —total elapsed time twelve minutes.



Operations at the HAYDEN CONCENTRATOR

Improvements in preceding operations eliminate 65 percent of flotation plant cells—Operations detailed—Accurate sampling and assaying essential—Complete copper inventory made every ten days—Actual recovery checks over four-year period within 2/100 of 1 percent with indicated recovery

By W. I. GARMS *

SINCE the last paper on the Hayden operations was delivered at this place on March 8, 1926, the following equipment changes have been made at the Concentrator:

The tables which were located between the fine crushing roll circuit and the fine grinding ball mill circuit and which produced a finished concentrate from the roll circuit product have been eliminated and the roll product now goes direct to the bowl classifiers of the fine grinding department.

Sixty-five percent of the flotation plant cells have been shut down due to improvements in the operations ahead of this department.

Only one filter is now required in the dewatering operations. The coarser mineral particles of the flotation concentrate are dewatered by gravity in the old gravity concentrate bins.

The eighth section of the concentrator has been equipped with an 8x14-ft. drag classifier, followed by a 9x12-ft. rod mill and a standard fine grinding department consisting of one 8x28-ft. bowl type drag classifier with an 18-ft. bowl, two 8x28-ft. drag classifiers and two 7x10-ft. ball mills. Other than the machinery on this section, no new equipment has been installed.

With the equipment now in place the plant will crush 12,000 tons to 10 percent on 100 mesh and 15,000 tons to 13 percent on 100 mesh.

The following operating changes have been effected:

Improvement in sectional capacity by a change in the screens used in the fine crushing roll circuits.

The use of 2-in. ball in place of 3-in. balls in the fine grinding mills.

Selective grinding of the minerals by the elimination of the primary slime material of the ore from the closed circuit classifiers of the fine grinding mills.

Selective flotation of the copper minerals by changing the points of addition of the lime and the collecting agent.

Increase in flotation cell capacities by the above improvement in the conditioning of the pulp, plus the use of a faster acting and more powerful collecting agent so that only a single cleaning is necessary and one-fourth as much equipment required as heretofore for the same tonnage.

The information on pages 13 and 14, prepared by Mr. F. J. Tuck, assistant mill superintendent, and Mr. J. L. Stevens, research chemist, gives in detail some of the interesting points in the Hayden operations.

*General Mill Superintendent, Arizona Division, Ray Mines, Nevada Consolidated Copper Company.

NEVADA CONSOLIDATED COPPER COMPANY HAYDEN PLANT MILLING STATISTICS YEAR 1928

Dry tons ore milled						3,234,600
Heading	% Tot. Cu.	1.250	% Ox. Cu.			.140
General tailing	% Tot. Cu.	.171	% Ox. Cu.			.092
General Concentrate	% Cu.	20.246	% Fe.	28.48	% Insol.	10.14
Extraction	% Tot.	87.06	% Sulphide	93.23	% Oxide	38.23
Lbs. crude lime per ton crude ore milled*						5.28
Lbs. free CaO per dry ton flotation feed						.728
Lbs. roll steel per dry ton crude ore						.145
Lbs. semi-steel grinding balls per dry ton ore milled						.99
Lbs. tube mill liner consumption per dry ton ore milled						.07
Lbs. 100% Raconite per dry ton flotation feed†						.074
Lbs. Yarmor pine oil per dry ton flotation feed						.130
Lbs. blast furnace oil per dry ton flotation feed						.020
Tons primary water used in mill per dry ton ore milled						3.03
Average life of roll shell—days						53.14
Average life of tube mill—5-inch silica liners—days						301
Average life of tube mill—2-inch cast liners (with lifter bars)—days						600
Average life of tube mill—3-inch cast liners (wave type)—days						630

* Approximately 2 lbs. per ton added at boots of roll circuit elevators: 3 lbs. per ton to ball mill feeds. † Approximately 75 percent added to the individual bowl overflows: 25 percent to the individual circulating classifier overflows.

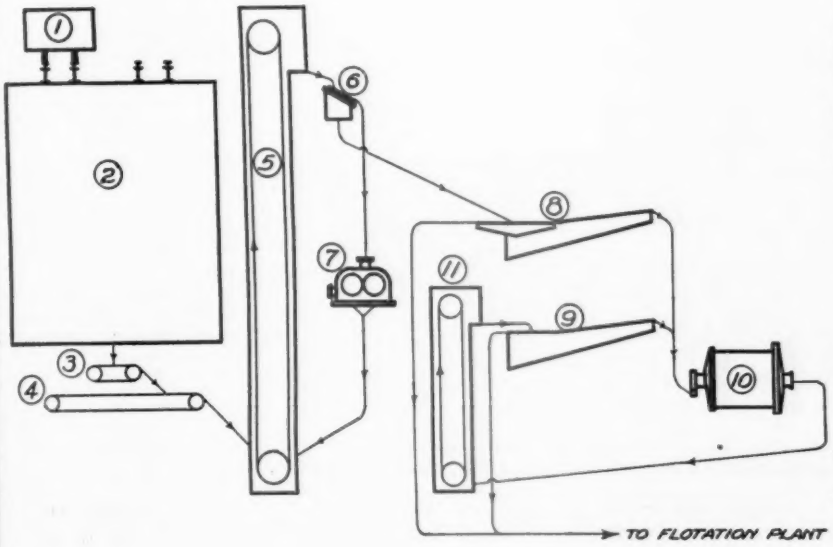
PRESENT MILL POWER CONSUMPTION

	Kw. hrs. per ton ore	Sub-total
Coarse Crushing (at mine)	.42	.42
Fine Crushing Department:		
Rolls	2.58	.....
Elevators	.68	.....
Auxiliaries	.18	3.44
Fine Grinding Department:		
Tube mills	3.15	.....
Elevators	.22	.....
Classifiers	.11	3.48
Flotation Conct. Dept.:		
Blowers	.87	.....
Pumps	.62	1.49
Dewatering—Filtering	.24	.24
Primary water	1.21	.....
Recovered water	.15	1.36
Industrial buildings and drag line	.08	.08
GRAND TOTAL	10.51	10.51

FINE CRUSHING AND FINE GRINDING FLOW SHEET

STANDARD 1500 TON SECTION-HAYDEN PLANT

NEVADA CONSOLIDATED COPPER COMPANY **HAYDEN, ARIZONA, SEPTEMBER, 1929**



LEGEND

1. 60-ton ore cars.
2. Ore bins, 3,200 tons.
3. Two Apron feeders 30" wide. Travel 12' per minute.
4. Conveyor. 20" belt. 230' per min. belt speed.
5. Elevator. 30" belt. 15" x 9" x 9" buckets spaced 19" alt. Belt speed, 400' per minute. 60' 6" c. to c.
6. Eight 3' x 4' impact screens. 576 vibrations per min. 7-mesh .047" wire.
7. Two 42" x 16" Garfield rolls. 125 r.p.m.
8. One 18' diam. bowl classifier. 2 r.p.m. 8' x 28' 4" drag. 17 strokes per min.
9. Two 8' x 28' 4" drag classifiers. 18½ strokes per min.
10. Two 7' x 10' tube mills. 16.4 r.p.m. and 16 2/3 r.p.m. 2" balls.
11. Two elevators. 16" belt. 24' 4½" c. to c. 369 f.p.m. 15" x 9" x 9" buckets, spaced 18".

SCREEN ANALYSES OF PRODUCTS OF FINE CRUSHING AND FINE GRINDING SECTION—1,500 TONS PER DAY

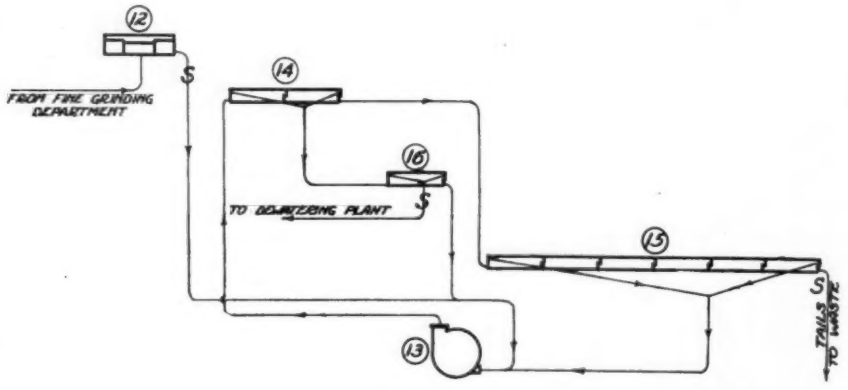
Opening or Mesh	Coarse Crushing Product. Feed to Fine Crushing Circuit. 1,500 tons per day.		Fine Brushing Product. Feed to Fine Grinding Circuit. 1,500 tons per day. 55% solids.		Fine Grinding Product. Feed to Flotation Plant. 1,500 tons per day. 32% solids.		Ball Mill Discharge. Two Ball Mills. 3,000 tons per day. 80% solids.	
	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.
.742"	5.64	5.64						
.525"	16.64	22.28						
.371"	14.89	37.17						
3 Mesh	12.21	49.38						
4 "	6.96	56.34						
6 "	6.14	62.48						
8 "	5.08	67.56						
10 "	4.26	71.82	1.1	1.1				
14 "	2.95	74.77	5.2	6.3			1.3	1.3
20 "	2.21	76.98	6.1	12.4			1.6	2.9
28 "	2.53	79.51	8.9	21.3			4.2	7.1
35 "	2.16	81.67	8.8	30.1			7.6	14.7
48 "	1.53	83.20	6.2	36.3			10.2	24.9
65 "	1.35	84.55	6.2	42.5	2.2	2.2	13.1	38.0
100 "	1.52	86.07	5.5	48.0	8.6	10.8	19.1	57.1
200 "	2.03	88.10	8.6	56.6	16.7	27.5	18.4	75.5
—200 "	11.90	100.00	43.4	100.0	72.5	100.0	24.5	100.0

Mesh	Primary Classifier Overflow. 675 tons per day. 30% Solids.		Circulating Class. Overflow. Two Classifiers. 825 tons per day. 34% Solids.		Primary Classifier Sands. Feed to two Ball Mills. 825 tons per day. 80% Solids.		Circulating Class. Sands. Feed to two Ball Mills. 2,175 tons per day. 80% Solids.	
	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.
10					2.0	2.0	0.7	0.7
14					9.5	11.5	1.1	1.8
20					12.1	23.6	2.2	4.0
28					15.1	38.7	5.3	9.3
35					16.1	54.8	10.5	20.3
48					11.2	66.0	11.8	32.1
65	1.0	1.0	3.2	3.2	10.5	76.5	19.1	51.2
100	4.0	5.0	11.3	14.5	6.7	83.2	21.6	72.8
200	10.2	15.2	23.0	37.5	7.3	90.5	17.8	90.6
200	84.8	100.0	62.5	100.0	9.5	100.0	9.4	100.0

FLOTATION PLANT FLOW SHEET

STANDARD 2000 TON MACHINE-HAYDEN PLANT

NEVADA CONSOLIDATED COPPER COMPANY HAYDEN, ARIZONA, SEPTEMBER, 1929



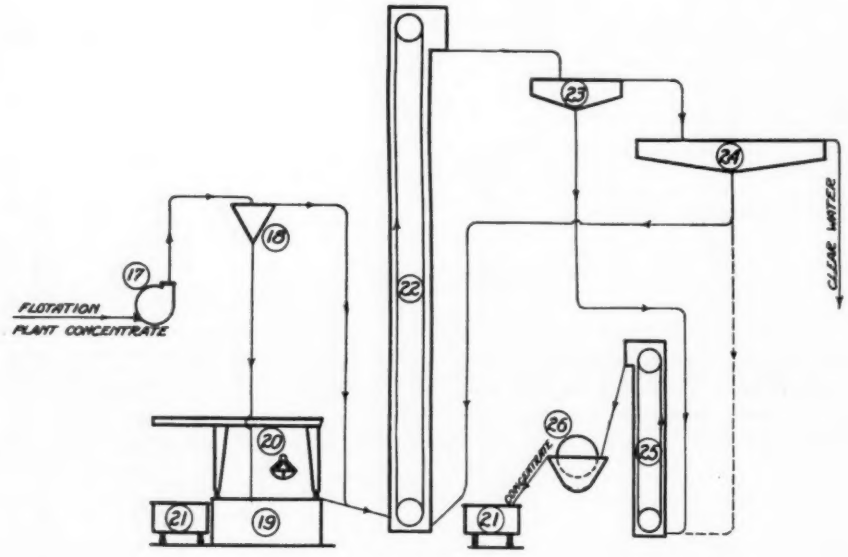
LEGEND

12. Distributor for four fine-grinding sections.
13. 6″ Wilfley pump.
14. Flotation primary roughers—two cells, each 15′ long by 30″ wide by 24″ deep at shallow end. Bottom slope ½″:12. 26 sq. ft. blanket area.
15. Flotation secondary roughers—6 cells same dimensions as primary roughers. 78 sq. ft. blanket area.
16. Flotation cleaner—one cell same dimensions as primary roughers. 13 sq. ft. blanket area.

SCREEN ANALYSES OF FLOTATION PLANT HEADING, TAILING AND CONCENTRATE

Mesh.	Flotation Plant Heading.		Flotation Plant Tailing.		Flotation Plant Concentrate.	
	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.
65	2.2	2.2	2.3	2.3	0.5	0.5
100	8.0	10.2	8.2	10.5	4.0	4.5
200	17.3	27.5	16.6	27.1	30.1	34.6
-200	72.5	100.0	72.9	100.0	65.4	100.0

DEWATERING PLANT FLOW SHEET—HAYDEN PLANT



LEGEND

17. 6″ Wilfley pump.
18. 8-ft. cone tank.
19. Coarse concentrate bins—270 tons each.
20. Gentry crane—4-ton Morgan.
21. 80-ton concentrate car.
22. Two elevators—one used. 18″ belt. 15″ x 9″ x 9″ buckets, spaced 20″. 400′ belt speed. 63′ c. to c.
23. One 40-ft. x 10′ 6″ Dorr settling tank.
24. One 75-ft. x 12′ Dorr settling tank.
25. Two elevators—one used. 14″ belt. 10″ x 6″ x 6″ buckets, spaced 16″ c. to c. 375′ belt speed. 37′ c. to c.
26. Three 12′ x 12′ Oliver filters and one 14′ x 14′ Portland filter—only one used.

Flotation Reagents and Methods of Control Employed at the Hayden Plant

The following reagents and methods of control are employed at the Hayden Concentrator:

Reagents used:

Lime

Raconite (Mixture of Sodium Butyl Xanthate and Thio-carbonates.)

Pine oil (Yarmor)

METHODS OF CONTROL

Lime

The lime is fed to the plant, in the form of milk-of-lime, through two distributing systems, "A" and "B."

Distributing System "A":

This system distributes the lime to the various sections of the fine crushing department.

The lime is pumped to the system from a large milk-of-lime supply tank through a 4-in. header pipe, which is tapped at each section. A large volume of milk-of-lime is pumped through the header pipe to prevent choking, the excess volume being returned to the supply tank.

The lime is added to the crude ore at the primary elevator on each section in quantities sufficient to protect the machinery (rolls, screens, elevator buckets, etc.) against the corrosive action of soluble mineral salts (principally copper sulphate) contained in the ore.

Alkalinity determinations are made on the screen undersize product and the rate of addition of lime varied so as to maintain only a slight degree of alkalinity.

The screen undersize product from the fine crushing department flows to an open circuit (primary) bowl classifier. The overflow of the bowl classifier constitutes part of the flotation feed and the drag sands from this classifier go to the fine grinding department.

The low lime alkalinity of the screen undersize pulp is reduced by the water used on the bowl classifier so that only a relatively slight degree of alkalinity is maintained in the bowl overflow pulp.

The fine grinding department consists of ball mills operating in closed-circuit with (secondary) drag classifiers.

The overflows from the primary bowl and secondary drag classifiers are combined for flotation treatment.

Distributing System "B":

This system distributes lime to the various sections of the fine grinding department, where the lime is added to the ball mill feed.

System "B" receives its lime through a 2-in. pipe line from the 4-in. header pipe of system "A."

A controlled amount of milk-of-lime is fed through the 2-in. pipe into a 100-gallon receiving drum, from which it is pumped through a 2-in. header pipe to the various sections. The 2-in. header pipe is tapped at each ball mill and the milk-of-lime fed through a bushing so that each mill receives approximately the same amount of lime.

In order to effect an equal distribution of lime throughout the various sections, water is added to the milk-of-lime in the 100-gallon receiving drum so as to permit a sufficient velocity through the header pipe to prevent settling and choking. The volume pumped through the header pipe is considerably greater than the volume discharged at the points of addition to the ore pulp. The excess volume is returned to the receiving drum for recirculation.

Alkalinity determinations are made on the flotation headings and the degree of flotation pulp alkalinity controlled by the rate at which the initial milk-of-lime is fed at the receiving drum.

The following shows typical alkalinities maintained at various points in the mill circuit:

	Alkalinity cc's N/28 HCl per 20 cc's of pulp water	
	Phenolphthalein Indicator	Methyl Orange Indicator
Screen undersize	0.3	1.1
Bowl classifier overflow	Trace	0.5
Ball mill discharge	15.0	15.9
Secondary classifier overflow	10.4	10.9
Flotation headings	4.0	4.4
Flotation tailings	3.5	3.7

The highest degree of alkalinity is maintained at the ball mills, where the lime is most effective in depressing the flotability of the pyrite.

While determinations of the pulp alkalinity at the head of flotation are useful in maintaining the optimum degree of pulp alkalinity for the flotation operation and also assist in preventing a waste of lime, local experience has clearly demonstrated that these determinations have little significance as regards conditioning the minerals for selective concentration, unless considered in conjunction with the points of lime addition. In other words, it has been found that by changing the points of lime addition the same degree of flotation pulp alkalinity may be maintained and at the same time effect an entirely different metallurgical result. For example, prior to practicing selective flotation at the Hayden Concentrator, part of the lime was added at the primary elevators ahead of the rolls and part to the classifier overflow pulps. The amount of lime employed was sufficient to protect the machinery against the corrosive action of soluble mineral salts contained in the ore and to maintain the most favorable degree of alkalinity in the flotation operation. This practice resulted in "bulk" flotation concentration; the free pyrite being recovered with the flotation concentrate almost as effectively as the copper minerals. Now, however, with the present method in which that portion of the lime, above the amount required at the roll circuit, is added to the ball mill feed, the free pyrite is selectively depressed so that it is available for rejection with the flotation tailings, even though the total amount of lime employed and the degree of flotation pulp alkalinity is substantially the same as with former practice.

It is readily seen that with the former practice the minerals throughout the entire mill circuit were never subjected to a degree of alkalinity higher than that maintained in the flotation head pulp. And, while it was known that some grading up of the concentrate could be effected by increasing the total pulp alkalinity, such practice was not warranted because of the large amount of lime required to maintain an effective alkalinity, and also because such high alkalinities are not desirable in the flotation operation.

With the present method of adding lime to the ball mill feed, where the pyrite is somewhat concentrated and the ratio of water to solids relatively very low, the pyrite is subjected to a degree of alkalinity sufficiently high to effectively depress its flotability. Reducing the alkalinity of the final ball mill product to the optimum degree for the flotation operation, by addition of water and slime pulp from the primary classifiers, does not destroy the effectiveness of the high alkalinity at the ball mills in depressing the flotability of the free pyrite.

ALKALINITY DETERMINATIONS

By titrating a 20-cc. sample of pulp water with N/28 acid, each cc. of acid is equivalent to one-tenth pound of CaO per ton of water. The pounds lime per ton of water may be reduced to pounds lime per ton of solids by multiplying the lime value of the water by the ratio of water to solids in the ore pulp.

While there are several objections to the titration method for indicating pulp alkalinities, local experience has been that the titration method is a better guide to operators and affords more uniform alkalinity control than determinations of the pH value of the pulp waters, particularly with the higher alkalinities.

Means for indicating, recording and controlling the flotation pulp alkalinity by measurement of the electrical conductivity of the pulp are being investigated with encouraging results; the intention being to eventually maintain the pulp alkalinity automatically by operating the lime valve electrically by high and low contacts on the recording instrument.

The apparatus used consists of a dip cell immersed in the pulp and a Leeds and Northrup automatic conductivity recorder which is a self-balancing alternating current Wheatstone bridge.

First experiments were made with a glass encased dip cell with platinum electrode. Foreign material collected within the case rendering the cell inoperative in a short time. The cell was then changed to give an unrestricted space around the electrodes and the operation

of the cell was more satisfactory. However, the platinum electrodes were attacked by the Raconite, and the formation of a thin film on the electrodes after a period of use changed the cell constant so that readings were inaccurate.

A different type of dip cell was designed using carbon disc electrodes. This cell operated much more satisfactorily than the platinum cell. One period of approximately 30 hours' operation checked the chemical titrations very closely. However, there is a tendency for the lime to form a film over the surface of the electrode. So far the experience shows that this may happen in a few hours or it may take 30 or more hours. Momentary immersion of the cell in acid removes the film and restores the cell to its original constant.

Tests are now being conducted on dip cells by removal from the pulp and immersion in acid at stated intervals in order to determine if the cell constant can be maintained at a uniform value. If these tests are successful, automatic means for periodically cleaning the cells with acid will then be provided. Further investigation on the control of the lime additions will be required but if a dip cell can be maintained with a uniform constant, the major problem will have been solved.

Raconite

The Raconite, a mixture of approximately 70 percent sodium butyl xanthate and 30 percent thio-carbonate, is pumped daily from the reagent manufacturing plant, in the form of an aqueous solution containing 1½ pounds of the mixture per gallon, to two mill supply tanks "A" and "B" from which the solution is alternately fed by gravity to the plant distributing systems.

Reagent Distributing Systems

The reagent distributing systems consist of, (a) receiving drums into which a measured amount of reagent, from the supply tanks, is continuously fed and diluted with a large volume of water, (b) main distributing pipe lines connected to the receiving drums to carry the solution to the various mill sections, and (c) small pipes which lead from the main pipe line at the various sections and deliver the solution to the desired points of addition to the ore pulp. Two such systems are employed; one for the south side mill sections and one for the north side sections.

The receiving drum consists of a 100-gallon steel drum set on end with the top end removed. The drum is located sufficiently high to permit gravity flow throughout the system.

A large volume of water (approximately 30 parts water to 1 part of Raconite solution) is permitted to flow into the receiving drum through a float-valve which regulates the amount. As much dilution water is thus admitted as can be handled by the various outlets in the distributing system. The outlets are restricted sufficiently to permit the desired distribution. The flow of the dilution water from the float-valve affords sufficient agitation to immediately disperse the Raconite.

Control of Raconite Addition

The amount of Raconite added is controlled by intermittently measuring the amount of solution fed to the distributing system from supply tank "A" or "B." A pet-cock is used to regulate the flow of the solution and is set to feed a certain volume during a stipulated period of time. The total amount of reagent used per shift is determined by measuring the quantity of solution drawn from the supply tanks.

Distribution of Raconite Solution

The Raconite is introduced into the ore pulp by adding the dilute solution to the overflow of all classifiers. The classifier overflow products are then combined for flotation treatment. At the present time approximately 75 percent of the Raconite is added to the primary slime pulp from the bowl classifier, and 12½ percent to each of the secondary classifiers overflow products on each mill section.

While the mineral content of the primary slimes is relatively low, the major portion of the Raconite is added to this product for the following reasons: *First.* Due to the refractory nature of the minerals in the primary slime pulp it is desirable to have an excess of reagent present in order to insure maximum recoveries. *Second.* The primary slime pulp yields a relatively high grade copper concentrate by "bulk" flotation due to containing a low ratio of pyrite to chalcocite, and therefore sufficient reagent is added to promote a "bulk" flotation condition. *Third.* Laboratory experiments have shown that by treating the reagent with the primary slime pulp prior to introducing it into the secondary classifier pulp, where the major portion of the pyrite is concentrated, the reagent may be conditioned so that it possesses a marked selective action on the copper minerals. This selective action is shown by the following results of laboratory tests in which all conditions were the same except the treatment of the reagent.

For test No. 1 the Raconite was added to the total ore pulp just prior to flotation, and for test No. 2 was added to the primary slime pulp and allowed two hours' contact prior to combining with the remainder of the total ore pulp for flotation treatment. The quantity of reagent was the same for each test.

FLOTATION RESULTS

Test No.	Headings		Tailings		Concentrates		
	% Cu.	% Fe.	% Cu.	% Fe.	% Cu.	% Fe.	% Ins.
1	1.09	4.07	.175	1.71	15.2	33.1	8.6
2	1.09	4.07	.185	2.57	23.8	28.7	8.9

While in large scale practice, the time of contact between the reagent and the primary slimes, prior to being mixed with the secondary sands, is short, the evidence is in favor of adding the major portion of the reagent to the slimes. In this way, selective concentration of the minerals is promoted, thus supplementing the effect of the lime in the ball mills in depressing the flotability of the pyrite.

It is local opinion that the addition of the major portion of the reagent to the primary slime pulp also results in reducing the amount of lime required to accomplish the same result, i. e., observations of plant operations indicate a tendency for operators to use more lime when the proportion of reagent fed the secondary classifiers overflow products is increased and the percentage added to the primary slime pulp correspondingly decreased.

The local reagent distributing system permits a more uniform distribution of the reagent than would be the case if the original concentrated solution were added at the various desired points. It also permits the original solution to be added at fewer points where the quantity can be easily controlled. Irregularities in quantities which might occur while regulating the concentrated solution are smoothed out by the large volume of dilute solution carried in the system.

When this system of distribution was first installed, fresh water was used for dilution and the pipes soon became clogged with calcium carbonate which was precipitated from the fresh water by action of sodium carbonate and sodium hydroxide present in the Raconite solution. This trouble has been partially overcome by substituting mill return water for the fresh water.

An auxiliary reagent distributing system has recently been installed for use on the south-side mill sections. This system functions similar to the ones above described except that the solution is pumped through the header pipe and the excess volume returned to the receiving drum for re-circulation. The pumping keeps the pipe system cleaner but some trouble has been encountered by a deposition of calcium carbonate at the pumps.

In general the reagent distributing system works very well; the trouble encountered by the deposition of calcium carbonate being practically negligible.

Pine Oil (Yarmor)

The pine oil is finally added to the combined classifier pulps at the primary distributers, where the pulp is distributed to various pumps for delivery to the flotation department.

The pine oil is fed from an oil feeder of the revolving drum type, and the quantity regulated to suit various ore conditions; some ores requiring more pine oil than others.

After the pine oil is added, the ore pulp is subjected to considerable agita-

tion by cascading and pumping, so that the pine oil is well mixed or emulsified with the pulp by the time it reaches the flotation machines.

Manufacture of Flotation Reagents at Hayden

Raconite is a special name locally given to a reaction product of a higher alcohol, carbon bisulphide, caustic alkali, and water, in which the carbon bisulphide and alkali are used in excess above the proportions theoretically required to form higher alcoholic xanthate. The excess ingredients go practically completely into the reaction, and, besides giving a maximum yield from the alcohol, form a reagent which is peculiarly effective in flotation.

On account of the higher alcoholic xanthates and raconites being flotation agents per se, that is, possessing both frothing and collecting powers, they function peculiarly with the froth in the flotation process, and result in an improved flotation condition more effective than that produced by the non-frothing mineral-collecting ethyl xanthate.

The higher alcoholic xanthates have been in use at Hayden since 1926, but it is only recently that their superiority over the ethyl xanthates has been recognized elsewhere. Many plants are now becoming quite interested in the new reagents, and some have already adopted them. Among such plants are the Clarkdale, McGill, and Hurley concentrators.

Because of the higher yield obtainable by the use of the excess carbon bisulphide and alkali, and also because of the use of water in the reaction product, the Hayden plant has seen fit to manufacture its own reagent.

Butyl alcohol has been employed at the Hayden plant because it has been available in large quantities of a uniformly high-grade product at a reasonable price. Normal butyl alcohol (purity 98 to 100 percent) is obtainable in tank-car lots from the "Commercial Solvents Corporation." This alcohol is sold under the trade name "Butanol." Amyl alcohol is now being produced and sold at reasonable prices, and makes a very fine flotation agent when combined with carbon bisulphide and alkali to form xanthates or raconites.

Theoretically, to make butyl xanthate, equi-molecular equivalents of butyl alcohol, carbon bisulphide and caustic alkali are needed. However, in practice the reaction results in the formation of other reaction products which consume part of the alkali and carbon bisulphide, leaving an equivalent amount of free alcohol. Substantially all of the alcohol may be consumed by using larger amounts of alkali and carbon bisulphide than are theoretically required.

In order to facilitate mixing and also to aid reaction, the alkali may be added in the form of a strong aqueous solution (preferably a saturated solution). In the formation of sodium butyl xanthate, part of the water used in dissolving the alkali is taken up as water of crystallization. The xanthate forms with two molecules of water of crystallization. Only one molecule of water is formed by the theoretical reaction of equi-molecular equivalents of the ingredients and therefore additional water is required to satisfy the reaction.

Any desirable proportions of the various ingredients may be employed in making products for flotation purposes, and any sequence of adding the chemicals may be used. At Hayden, the product termed "Raconite" is made up as follows:

The caustic soda is dissolved with sufficient water to produce a solution of 1.5 Sp. Gr. Sufficient of the caustic soda solution for several batches of Raconite is made up at one time and allowed to cool before using.

The desired amounts of butyl alcohol and carbon bisulphide are measured out and placed in a water cooled mixing tank, and a measured quantity of the caustic soda solution slowly added. The caustic soda is added slowly in order to prevent excessive rise in temperature during the reaction. The temperature is held below 113° F. until the bulk of the caustic soda is added but is allowed to increase to about 120° F. at the end of the reaction. After all the alkali is added the agitation is continued until the temperature shows a substantial drop. The batch is then diluted for plant use. The mixing tank is provided with a reflux condenser to prevent losses of carbon bisulphide by volatilization. However, practically all of the carbon bisulphide is consumed by reaction before the temperatures reach the boiling point of carbon bisulphide.

The quantities of ingredients used in preparing a batch of Raconite are based upon the following reaction equation:

$$4C_4H_9OH + 7CS_2 + 10NaOH = \underbrace{4C_4H_9OCS_2Na + 2Na_2CS_3}_{\text{Sulphur-compounds}} + Na_2CO_3 + 7H_2O$$

As mentioned above, the xanthate forms with two molecules of water of crystallization, but, in calculating the yield, this water is not considered in the above equation. The theoretical yield of the above underlined "Sulphur compounds" is used locally as an arbitrary basis for rating the strength of aqueous solutions of this product.

To make a 100-pound batch of the above sulphur compound (Raconite) the following weights of materials are used:

Butyl alcohol—C_4H_9OH.....	29.72 lbs.
Carbon bisulphide—CS_2.....	53.41 lbs.
Caustic soda—NaOH.....	40.17 lbs.

With these proportions the reaction is substantially complete and the product is more effective for treating the local ore than straight xanthate.

For plant use the product is diluted with water to 1.5 lbs. of Raconite per gallon of solution.

Some decomposition results from allowing this product to stand in an aqueous solution for a considerable length of time. Best results are obtained from fresh solutions, i. e., solutions that are not more than four or five days old. At Hayden it is the aim to mix up a fresh batch of Raconite every morning and pump the solution to the mill system the following day. The amount of labor required for making a batch is not much greater than that required for dissolving and handling crystalline ethyl xanthate.

Accounting for the Copper

An accurate check on the copper that comes to the Hayden mill in the form of crude ore and goes out in the form of concentrate and tailing is dependent upon many factors, the most important being painstaking sampling and assaying. Weakness in either department would set at naught the whole system of accounting for copper.

The close check obtained at the Hayden plant between "Indicated" and "Actual" recovery is indicative of the accuracy of the procedure used in obtaining the factors for this accounting.

The ore as received from the mine is weighed on railroad scales by the Southern Pacific Railroad Company. A moisture sample is taken while the ore is being dumped into the bins. The bins are measured every morning at 7.30 a. m., and from such measurements, and the receipts between measurements, the dry tonnage milled for the 24-hour day is determined.

The ore is not sampled for copper content until it has been put through the fine crushing and fine grinding departments and is in the form of pulp ready for distribution to the flotation machines. There is no doubt that fine ore, well mixed, affords more accurate sampling than coarse ore fed from large bins onto a conveyor. The pulp, as fed to the flotation machine, is a very homogeneous mixture, and with automatic samplers cutting, at intervals of six minutes, the various streams from the main distributors, very reliable samples are obtained. At least four of these samples are obtained for each eight-hour shift, making 12 samples in all for the 24-hour run. Each of these samples is assayed in duplicate, and a composite heading assay for each shift thus obtained.

The dry weight of ore milled for 24 hours times the average copper assay gives the number of pounds of copper in the mill heading to be accounted for in the concentrate and tailing.

As in the case of the heading assay, very accurate determinations of the tailing and concentrate assays are made for the 24-hour run. Automatic cuts, at six-minute intervals, of the general tailing and concentrate streams give reliable samples.

The indicated extraction in percent is calculated from the formula $\frac{C\ (H-T)}{H\ (C-T)}$

where

H = Assay of the heading.
C = Assay of the concentrate.
T = Assay of the tailing.

The indicated ratio of concentration is calculated from the formula $\frac{C-T}{H-T}$

This ratio divided into the tons ore milled gives the indicated tons concentrate produced.

The indicated extraction times the

copper in the heading gives the indicated recovery in pounds of copper. The difference between the pounds of copper in the heading and the indicated recovery gives the indicated pounds of copper in the tailing.

The concentrate produced is segregated into coarse and fine products, the coarse going to settling bins, and the fine to the filtering plant. The segregated products are shipped in separate cars to the American Smelting and Refining Company, where they are weighed and sampled in the presence of a mill representative. Duplicate moisture and assay samples are delivered to the mill for check purposes. Concentrate pulps showing a difference in assay value between the Smelting Company and the Mining Company which can not be settled by agreement are submitted to umpire assayers.

The pounds of copper received by the Smelting Company, as determined from weights and moistures and "split" or umpire assays, represent the actual recovery for the mill.

Auger sampling of the concentrate as produced at the filter and bins is practiced as a check on the smelter sampling. This is a further check on the accuracy of the general concentrate assay made on the flotation plant product. The concentrate in the bins is measured every morning, and an estimate made of the weight of the filtered and bin products loaded into the cars during the previous 24 hours. This gives an estimate of the daily production of concentrate to compare with the indicated tonnage as determined by the formula given for the ratio of concentration. Due to there being a variable amount of concentrate left in the pump sump each morning, together with a variable pulp density in the filter thickeners, the daily check is not as close as one taken over longer periods. Hence, every 10 days a complete copper inventory of copper actually settled for by the smelter, copper in transit, in bins, and in thickeners is made and this parallels quite closely with the indicated figure obtained by assays. As an example of this close accounting, the recovery results for the last four years are shown in the table below.

From the above it will be noted that there is a difference of only 39,905 lbs. between the indicated and actual copper recovered, out of a total of nearly 284 million pounds of copper, or a difference of less than two hundredths of 1 percent.

HEATING COKE OVENS

(*From page* 175)

bottom of the ovens.

Having established this approximate limit for our particular system with straight blast furnace gas, a further decrease in coking time was obtained by increasing the heat value of the fuel gas by enrichment with coke oven gas.

For a short period the mixed gas was regenerated but tests showed evidence of cracking of the coke oven gas in the regenerators, thus destroying to some extent the effectiveness of the enrichment.

Coke oven gas was then introduced directly through the coke oven gas system, with the result that we are now operating at a rate of 11 hours coking time, but at some sacrifice in fuel efficiency.

Up to the point where the speed of the gases in the flues approached the speed of flame propagation, the efficiency of the straight blast furnace gas was about equal to that obtained with coke oven gas.

Two months' operation at 12.9 hours coking time gave an average of 1,039 B. t. u. per pound of wet coal coked.

At the same speed and operating on the same coal mixtures, coke oven gas averaged 1,071 B. t. u. per pound of wet coal charged. In each case coke was pushed at an average temperature of approximately 1,775 degrees F., with flue temperatures between 2,350 and 2,430 degrees F.

With the same average coke temperature, the air port temperature in the flues is about 150 degrees F. lower with furnace gas. The temperature of the coke is approximately the same from top to bottom of the oven, which has been one of the prominent features noted with the use of blast furnace gas.

This uniform heating is directly reflected in the quality of the coke produced, not only as to size of pieces but also in the physical structure, as evidenced by less variation in the porosity and density of the coke at different levels in the oven. For example, with oven gas the apparent specific gravity of our furnace coke varied from .82 at a point 1 ft. below the top of the charge to .92 at a point 1 ft. above the bottom. With furnace gas, the same points show .81 and .85, respectively, or a difference of only .04 from top to bottom, as against .10 with coke oven gas. We feel that the effect of this more uniform fuel is found in our furnace operation, which has been exceptionally smooth throughout the entire time the ovens have been underfired with blast furnace gas.

During the six months' period from November 1, 1928, to May 1 of this year, the two furnaces have produced an average of 1,084 tons of iron per day on 1,611 pounds of coke per ton of iron. During the same period for the preceding year, the average iron production amounted to 977 tons per day on 1,651 pounds of coke per ton of iron. During both periods approximately 20 percent of the iron produced was of foundry grade and the quantity of scrap used was about equal. While this increase of 107 tons of iron per day, with a reduction of 40 pounds of coke per ton of iron, is not due entirely to the quality of the fuel used, we have every reason to believe that this was an important factor.

In considering this project of underfiring with blast furnace gas, there were some questions that only actual experience could answer satisfactorily. I shall here review briefly some of the points that have been more or less established by our experience so far.

As previously stated, no major operating difficulties have been encountered in any of the departments of gas cleaning, delivery and heating. There has been no indication so far of any deleterious effects of blast furnace gas upon the oven brickwork. Very recently two regenerators were examined and showed no deposits nor other ill effects attributable to the blast furnace gas.

While we have not operated long enough at speeds below 12-hour coking time to establish reliable figures on what heat consumption and gas yield may be attained, the data available indicates that maximum efficiency in this respect is probably reached at a little less than 12 hours coking time. Below this speed no increase in surplus gas is obtained, due to additional coal tonnage, as the gas required for enrichment equals the increased production and begins to exceed it below 11.5 hours time, resulting in less total surplus oven gas at 11 hours than at 12 hours. It must be borne in mind that these statements apply only to our particular conditions and are not necessarily true of ovens designed with larger fuel and waste gas capacity.

In order to visualize more clearly the relation between fuel gas consumption, surplus gas yield and coking time, I direct your attention to the chart which shows the approximate relations established by our operation using blast furnace gas.

Year	Indicated Lbs. Copper Recovered	Actual Lbs. Copper Recovered
1925	76,908,411	76,947,957
1926	71,014,451	70,960,335
1927	65,454,928	65,579,968
1928	70,458,066	70,387,501
Total four years	283,835,856	283,875,761

MINERAL PRODUCTION in 1929

Bureau of Mines issues annual statistics on Mineral production —Copper output largest in history of industry—Lead and zinc have interesting record—Gold and silver output declines—Industry as a whole makes excellent record.

MINERAL production statistics for 1929 have been issued by the United States Bureau of Mines. Copper had a record year, even surpassing its war record. Lead and zinc producers had a good year, and prosperity seemed to obtain in the metal producing states with the exception of Colorado. Substantial dividends were paid by many of the leading producers.

The estimated total value of mineral products in the United States in 1929 was approximately $5,900,000,000, as announced by the bureau. This is an increase of nearly 10 percent over the total value of mineral products in 1928, and is due to increases in the total value of metals and the mineral fuels produced. The total value of non-metallic mineral products in 1929 decreased slightly as compared with 1928. The increase in the value of metallic products is due chiefly to the increase in quantity and unit value of copper and iron produced. Lead and zinc also increased, but gold and silver decreased. The value of each of the mineral fuels produced showed increases, especially petroleum and natural gas. The total quantity of petroleum produced changed little, but there was a slight increase in the unit value. On the other hand, the total quantity of coal produced increased appreciably, but the total value increased relatively less, because unit values were lower.

The following figures give the estimated total value of metallic mineral products and non-metallic mineral products other than fuels and of mineral fuel produced in the United States in 1929:

Metallic	$1,540,000,000
Nonmetallic (other than fuels)	1,200,000,000
Mineral fuels	3,160,000,000
Total	$5,900,000,000

These estimates are subject to revision and replacement by precise figures for 1929 as soon as the Bureau of Mines can complete the canvass of mineral industries just begun. In this canvass the bureau is sending to every mining, quarrying, and well-operating company an inquiry soliciting a report on the output of each mineral commodity by each producing establishment. Early success in this undertaking is dependent upon the continuation of the prompt and cordial response on the part of the mining companies, which through many years has been the basis of success in this statistical endeavor.

Arizona

THE value of the gold, silver, copper, lead, and zinc produced by mines in Arizona in 1929 was about $158,433,300, an increase from $114,300,381 in 1928. The mines of this state not only made a general increase in the output of the five metals, but a remarkable increase in the output of copper, which gives a new record for the state far in excess of the record of 1918, when the total was 764,855,874 pounds of copper. The large producers of copper responded to the increased price of the metal, especially during the first six months of the year, and made a production of copper which exceeded that of 1928 by more than 101,000,000 pounds. There was a large increase in the output of gold corresponding to the abnormal increase in the output of copper, but the decrease in gold from gold ore in Mohave County was pronounced. The prices of lead and zinc did not result in a marked increase in the state totals for lead and zinc. Large expenditures were made in improvements at the copper smelters, in construction work on a copper refinery at El Paso, Tex., and in building new mills, especially at the Verde Central mine at Jerome and the Christmas mine in Gila County.

Dividends amounting to $27,611,659 were reported in 1929 by the following mining companies: Calumet & Arizona, United Verde, Inspiration, United Verde Extension, Miami, Magma, New Cornelia, and Arizona Commercial. Dividends of $5,500,000 were also paid, it is reported, by the Phelps Dodge Corporation, which operates the Copper Queen and Morenci properties in Arizona and other mines in Mexico and New Mexico. Profits from the Ray mine are included in dividends of $3,937,500 reported paid by the Nevada Consolidated Copper Co., operating properties in Nevada, Arizona, and New Mexico.

The gold output increased from $3,967,488 in 1928, to about $4,217,000 in 1929, due to the unusual activity at the leading copper mines.

The silver output increased from 6,791,351 ounces in 1928 to about 7,257,000 ounces in 1929, but the value decreased from $3,972,940 to about $3,875,000 as the average price of silver decreased from 58.5 cents an ounce in 1928 to 53.4 cents an ounce in 1929. The output of silver from Arizona mines has gradually increased in recent years and the state ranked fourth in the production of this metal after Utah, Montana and Idaho. The United Verde mine continued to exceed all other mines in the state as the largest silver producer.

The copper output increased from 732,276,803 pounds in 1928 to about 833,525,000 pounds in 1929, and the value from $105,447,860 to about $149,200,000. The largest copper producers in 1929 were the United Verde, Copper Queen, Inspiration, New Cornelia, Nevada Consolidated (Ray mines), Miami, United Verde Extension, Morenci, Calumet & Arizona, Magma, Old Dominion, and Shattuck Denn mines.

The lead production in Arizona increased from 14.380,964 pounds in 1928 to about 15,500,000 pounds in 1929, and the value from $834,096 to about $984,250. The Seventy-nine mine at Hayden Junction in Gila County took first place as the largest lead producer in Arizona.

The output of zinc recovered chiefly from mines in Santa Cruz County increased from 1,278,636 pounds in 1928 to about 2,357,000 pounds in 1929, and the value from $77,997 to about $156,800.

Alaska

MINES in Alaska are estimated to have produced minerals to the value of $16,105,000 in 1929, as against $14,061,000 in 1928. The total value of the mineral output of Alaska since 1880, is approximately $616,000,000. The source of this mineral wealth was approximately as shown below.

Gold

The total production of gold from Alaska mines in 1929 is estimated at $7,748,000. This marks a noteworty increase over the production of the preceding year, attributable to increased output by both lode and placer mines. The greatest increase appears to have come from placer mines, so that the ratio of the value of the gold produced by them to that of the gold produced by the lode

VALUE OF MINERAL OUTPUT OF ALASKA IN 1929 AND 1928

	1929 (est.)	1928
Gold	$7,748,000	$6,845,000
Copper	7,233,000	5,965,000
Silver	240,000	266,000
Coal	496,000	662,000
Other minerals (lead, petroleum, marble, tin, platinum, etc.)	388,000	323,000
	$16,105,000	$14,061,000

mines appears to have been about 51.4 to 48.6, whereas in the preceding year more gold was recovered from lodes than from placers. For the entire period that gold mining has been in progress in Alaska, however, the placers have yielded about two-thirds of the gold produced and the lodes only about one-third.

The large increase in production of gold from placer mines is attributable mainly to the greater output from the properties of the Hammon Consolidated Gold Fields in the Nome region and of the Fairbanks Exploration Company in the Fairbanks region. The weather conditions that affect mining, such as plentiful water supply and length of season, were especially good during 1929, and contributed in no small measure to an increased production from many of the smaller camps. Two new dredges were built in the Fairbanks district, one old dredge in the Nome district was moved to a new location and rebuilt, and extensive repairs were made to several of the other dredges that lately had been idle. Approximately 70 percent of all the placer gold that was recovered in Alaska in 1929 was mined by these machines, whereas in 1928 the ratio was 65 percent.

The increase in the production of gold from the lode mines is attributable largely to the output from properties of the Alaska Juneau Gold Mining Company in southeastern Alaska, which was both greater in quantity than in the preceding year and of a somewhat higher gold tenor.

Copper

The value of the copper produced from Alaska mines in 1929, is estimated to have been $7,233,000. This marks an increase of about $1,268,000 over the corresponding value in 1928, though the quantity produced showed a decrease amounting to more than 1,000,000 pounds. The increase in value is accounted for by the fact that the average selling price of copper, as computed by the Bureau of Mines, was 17.9 cents in 1929, against 14.4 cents in 1928. In 1929, as in former years, practically all of the copper came from two mines near Kennecott, in the Copper River region, and from one mine on Latouche Island, in the Prince William Sound region. These mines alone, according to the published records of the Geological Survey, have yielded copper worth more than $200,000,000 in the 19 years or so that they have been actively developed.

Search for new ore bodies and for extensions of the known ore bodies has been continued at all the producing mines, and development work has been carried on at several of the other properties not yet reached a producing stage. Among the places where the most active prospecting for copper ores has been carried on during the year may be mentioned the Nelson prospect, on Glacier Creek, a tributary of Chitistone River, in the Nizina Valley, where a force of men have driven several hundred feet of tunnel to prospect the outcroppings of high-grade copper ore that have been found there. This work is being done by the Kennecott Copper Corporation under option from the owner, and doubtless if the results of the exploration are satisfactory the property will be developed to a producing stage. In that event at least 25 miles of new railroad will be required for shipping the ore.

Silver

Most of the silver produced in Alaska during recent years has been recovered from the copper ores—in fact, during 1928, the latest year for which complete reports are available, over three-quarters of the silver came from that source. With the reduction in the output of copper ore in 1929 the quantity of silver naturally shows a corresponding decrease. Furthermore, the average selling price of silver was only 53.4 cents an ounce, against 58.5 cents in 1928. Owing to the greater output of gold from both lodes and placers there was some increase in the output of silver associated with the gold. The quantity of silver contained in ordinary lode or placer gold is, however, relatively so small, and silver is so low in price, that the increase of nearly a million dollars in the output of gold means an increase of only a few thousand dollars in the value of the silver recovered from those sources.

In addition to the mineral products already mentioned, Alaska also produced during 1929 some lead, marble, limestone, tin, quicksilver, and platinum. The aggregate value of the output of these minerals in 1929, together with that of petroleum, is estimated to have been $388,000. Most of the lead was obtained as a by-product from the gold ores of the Alaska Juneau mine, and the increased production of those ores resulted in the recovery of a greater amount of lead, also.

California

THE total value of the gold, silver, copper, lead, and zinc produced from ore mined and treated in California decreased from $15,381,783 in 1928 to about $14,998,700 in 1929. No zinc ore was mined in the state in 1929 though a small quantity of zinc was recovered from treating lead-silver ores mined in Inyo County. Copper was the only metal to make an outstanding increase in its yield compared with 1928 and its gain in value practically offset the loss in the gold yield recorded in 1929.

The value of the gold recovered from lode and placer mining in 1929 is estimated at about $8,392,800 compared with a value of $10,785,315 in 1928.

The quantity of silver mined and treated decreased from 1,478,771 ounces in 1928 to about 1,066,100 ounces and the value from $865,081 to $569,300.

The production of copper in California increased from 25,150,743 pounds in 1928 to about 33,255,500 pounds in 1929, and the value from $3,621,707 to $5,952,700.

The output of lead decreased from 1,891,037 pounds in 1928 to about 1,274,000 pounds in 1929, and the value from $109,680 to $80,900.

The small quantity of by-product zinc reported in 1929 came from the milling of lead-silver ore and probably did not exceed 50,000 pounds.

Colorado

THE estimated output of gold, silver, copper, lead, and zinc from Colorado mines in 1929 in terms of recovered and estimated recoverable metal was 211,381 fine ounces of gold, 4,323,387 ounces of silver, 8,352,000 pounds of copper, 49,-

Gold, silver, copper, lead, and zinc mined in Colorado in 1929, by counties in terms of recovered or recoverable metals.

County	Gold*	Silver*		Copper		Lead		Zinc		Total Value
	Value	Fine ozs.	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Adams	$3,948	28	$15	.....	.....	.....	.....	.....	.....	$3,963
Boulder	36,217	11,873	6,340	.....	.....	34,000	$2,159	.....	.....	44,716
Chaffee	351	933	498	6,000	$1,074	41,000	2,604	.....	.....	4,527
Clear Creek and Gilpin	191,752	191,977	102,516	162,000	28,998	545,000	34,607	50,000	$3,325	361,198
Denver	124	.....	.....	.....	.....	.....	.....	.....	.....	124
Dolores	11,742	216,000	115,344	262,000	46,898	7,500,000	476,250	5,526,000	367,479	1,017,713
Eagle and Summit	118,987	909,116	485,468	2,916,000	521,964	858,000	54,483	2,640,000	175,560	1,356,462
Gunnison	6,532	10,513	5,614	7,000	1,253	150,000	9,525	185,000	12,303	35,227
Hinsdale	4,382	2,800	1,495	.....	.....	120,000	7,620	9,000	598	14,095
Lake	137,612	427,000	228,018	125,000	22,375	10,874,000	690,499	27,000,000	1,795,500	2,874,004
La Plata	113,488	83,300	44,482	.....	.....	72,000	4,572	.....	.....	162,542
Mineral	992	631,000	336,954	.....	.....	281,000	17,844	.....	.....	355,790
Moffat	124	.....	.....	.....	.....	.....	.....	.....	.....	124
Montezuma	145	.....	.....	.....	.....	.....	.....	.....	.....	145
Ouray	414,553	18,000	9,612	23,000	4,117	86,000	5,461	.....	.....	433,743
Park	191,504	10,000	5,340	.....	.....	145,000	9,207	.....	.....	206,051
Pitkin	.....	97,000	51,798	.....	.....	1,400,000	88,900	212,000	14,098	154,796
Rio Grande	33,633	6,016	3,213	5,000	895	55,000	3,493	.....	.....	41,234
Saguache	21,457	750,000	400,500	2,750,000	492,250	6,000,000	381,000	.....	.....	1,295,207
San Juan	408,910	821,831	438,858	2,063,000	369,277	19,145,000	1,215,707	23,690,000	1,575,385	4,008,137
San Miguel	77,251	127,000	67,818	33,000	5,907	2,445,000	155,258	.....	.....	306,234
Teller	2,595,928	9,000	4,806	.....	.....	.....	.....	.....	.....	2,600,734
Total, 1929	4,369,632	4,323,387	2,308,689	8,352,000	1,495,008	49,751,000	3,159,189	59,312,000	3,944,248	†15,276,766
Total, 1928	5,304,876	4,052,253	2,370,568	8,594,646	1,237,629	53,501,723	3,103,100	71,462,000	4,359,182	‡16,375,355
Increase or decrease from 1928	—935,244	+271,134	—61,879	—242,646	+257,379	—3,750,723	+56,089	—12,150,000	—414,934	—1,098,589

*Includes placer production. †Average value of metals: Gold, $20.671835 per ounce; silver, $0.534 per ounce; copper, $0.179 per pound; lead, $0.0635 per pound; zinc, $0.0665 per pound. ‡Average value of metals: Gold, $20.671835 per ounce; silver, $0.585 per ounce; copper, $0.144 per pound; lead $0.058 per pound; zinc, $0.061 per pound.

751,000 pounds of lead, and 59,312,000 pounds of zinc. These figures are to be compared with 256,623 fine ounces of gold, 4,052,253 ounces of silver, 8,594,646 pounds of copper, 53,501,723 pounds of lead, and 71,462,000 pounds of zinc in 1928. Compared with 1928 figures, gold shows a decrease of $935,244, silver an increase of 271,134 ounces, copper a decrease of 242,646 pounds, lead a decrease of 3,750,723 pounds, and zinc a decrease of 12,150,000 pounds. The gross estimated value of the output of metals in Colorado in 1929, is gold $4,369,632, silver $2,308,689, copper $1,495,008, lead $3,159,189, zinc $3,944,248, or a total of $15,276,766, compared with $16,375,355 in 1928.

The Cripple Creek district in 1929 produced $2,595,928 in gold, as compared with $3,059,181 in 1928.

Idaho

THE estimated value of the gold, silver, copper, lead, and zinc produced from ore mined in Idaho in 1929 was about $32,278,490 as compared with $26,667,706 in 1928. Substantial increases were recorded in the production of silver, copper, lead, and zinc, and the value of the output was greater than any year since 1918, despite a slight decrease in the output of gold. Regular smelting operations were conducted at Kellogg, the electrolytic zinc plant at Silver King was operated throughout the year, and the capacity of the Bunker Hill lead refinery was increased.

According to published reports, mining companies paid dividends amounting to approximately $5,075,000, compared with $4,470,427 paid in 1928.

The mine output of gold in 1929 was valued at about $403,100 as compared with $433,703 in 1928.

The output of silver increased nearly 6 percent, from 8,998,330 ounces in 1928 to about 9,535,000 ounces in 1929, but the value decreased from $5,264,023 to about $5,091,690, on account of a decrease in the average price of silver.

In the Coeur d'Alene district, which produced at least 8,800,000 ounces of silver, about 76 percent of the product was recovered from the ores of the four largest producers, the Bunker Hill & Sullivan, Sunshine, Hecla, and Morning mines, which ranked in the order given.

The output of copper increased from 2,072,165 pounds in 1928 to about 4,888,000 pounds in 1929, and the value increased from $298,392 to about $874,950.

The output of lead increased from 290,645,905 pounds in 1928 to about 304,230,000 pounds in 1929, and the value from $16,857,462 to about $19,318,600, as a result of general activity and a slight increase in the average price of the metal. The Bunker Hill & Sullivan, Morning, and Hecla mines were as usual the three largest producers.

The zinc recovered from ore and concentrate increased from 62,526,648 pounds in 1928 to about 99,100,000 pounds in 1929. and the value from $3,814,126 to about $6,590,150; the average price of zinc was slightly higher than that of 1928. About 70 percent of the zinc output was recovered by roasting and leaching at the electrolytic plants at Great Falls and Anaconda, Mont., and the remaining 30 percent was recovered at the new plant of the Sullivan Mining Company near Kellogg. The Morning mine exceeded all others in zinc production and produced about 38 percent of the total recovered zinc in the state.

Montana

THE value of gold, silver, copper, lead, and zinc produced from Montana mines in 1929, according to estimates made by C. N. Gerry, of the Bureau of Mines, was about $75,049,500, an increase from $55,365,249 in 1928.

The value of the gold output decreased from $1,203,020 in 1928 to about $1,054,200 in 1929. The largest gold producers in the state were the Anaconda, Spring Hill, Liberty Montana, Butte & Superior, St. Louis, New Gould, and Butte Copper & Zinc properties. Despite the large output of copper, there was a decided decrease in gold from copper ores.

The mine output of silver increased from 10,853,276 ounces in 1928 to about 12,650,000 ounces in 1929, and the value from $6,349,166 to about $6,755,000.

The copper output increased from 248,262,027 pounds in 1928 to about 298,600,000 pounds in 1929, and the value from $35,749,732 to about $53,450,000.

The production of lead increased from 33,759,644 pounds valued at $1,958,059 in 1928 to about 39,500,000 pounds valued at $2,508,250 in 1929. The increase of about 17 percent in the production of lead was due chiefly to the unusually large output from the Block P. mine, owned by the St. Joseph Lead Company.

The output of zinc recovered from ore mined in Montana increased from 165,660,189 pounds in 1928 to about 169,660,000 pounds in 1929, and the value from $10,105,272 to about $11,282,000. The electrolytic zinc plants near Great Falls and Anaconda were operated continuously treating concentrate from Anaconda and Butte and considerable custom material, chiefly from Utah, Idaho, and Montana. Nearly 82 percent of the total output of zinc from Montana mines was produced from six properties at Butte.

New Mexico

THE estimated output of gold, silver, copper, lead, and zinc from New Mexico ores and gravels in 1929, in terms of recovered and estimated recoverable metal was 34,200 ounces of gold, 1,090,000 ounces of silver, 22,000,000 pounds of lead, 100,000,000 pounds of copper, and 68,000,000 pounds of zinc. These figures are to be compared with a production in 1928 of 32,912 ounces of gold, 827,793 ounces of silver, 15,610,501 pounds of lead, 89,854,646 pounds of copper, and 62,406,000 pounds of zinc, and show substantial increases in all metals. The estimated gross value of the New Mexico metal production is gold $707,000, silver $582,000, lead $1,397,000, copper $17,900,000 and zinc $4,522,000 or a grand total of $25,108,000 compared with $18,815,863, an increase of $6,292,137 or 33 percent.

Nevada

THE value of gold, silver, copper, lead, and zinc in Nevada increased from $31,033,776 in 1928 to about $31,302,000 in 1929. Compared with 1928 production there were decreases in the output of all metals except lead and zinc, though the value of the copper output in 1929 increased, due to better price conditions of the metal.

The gold output decreased from $3,620,833 in 1928 to about $3,251,000 in 1929.

The silver production decreased from 5,481,574 ounces in 1928 to about 4,583,000 ounces in 1929, and the value from $3,206,721 to about $2,447,000. The output from the Comstock district decreased from 37,679 ounces to about 11,000 ounces. The Tonopah district produced about 1,905,000 ounces of silver, a slight increase from 1,900,315 ounces in 1928. The Tonopah Mining Company was the largest silver producer in the state, followed closely by the Tonopah Extension.

The copper output decreased from 158,876,883 pounds in 1928 to about 131,967,000 pounds in 1929, but the value increased from $22,878,271 to about $23,622,000. The Nevada Consolidated Copper Company, operating its mine, mill, and smelter at Ely and McGill was the largest producer of copper in the state although the general policy to curtail production was followed.

The lead output increased from 15,747,444 pounds in 1928 to about 16,467,000 pounds in 1929, and the value from $913,352 to about $1,046,000.

The zinc recovered from ore mined in Nevada increased from 6,796,713 pounds in 1928 to about 14,082,000 pounds in 1929, and from $414,599 in value to about $936,000.

Oregon

THE total value of the gold, silver, copper, and lead produced from ore sold or treated in Oregon in 1929 increased from $296,446 in 1928 to about $529,000 in 1929. There were increases in the output and value of all metals, with gold and copper showing the largest gains, respectively. Production resulted from fewer mines operating than in the previous year and came mostly from gold and copper operations in southwestern Oregon. The output of metals in eastern Oregon came largely from two dredges and two gold lode mines operating in Baker and Grant counties.

The total gold yield of Oregon increased from 10,931 ounces in 1928, valued at $225,968, to about 18,400 ounces in 1929, valued at about $380,300.

The silver yield of Oregon increased from 30,924 ounces in 1928 to about 37,700 ounces in 1929, and the value from $18,091 to about $20,000.

The output of copper in Oregon increased from 358,463 pounds in 1928 to about 710,000 pounds in 1929 and the value from $51,619 to about $127,000.

South Dakota

METAL mines in South Dakota in 1929 produced $6,523,000 in gold and 85,000 ounces in silver. This compares with the production in 1928 of $6,560,805 in gold and 90,547 ounces of silver. The production of the Homestake mine, the largest producing gold mine in the United States, was apparently slightly less than its 1928 production. The only other producing mine in 1929 was the Keystone Consolidated Mines, Inc., near Keystone.

The Bald Mountain Mining Company, which in October, 1928, purchased the Trojan group, formerly an important producer of low grade gold ore treated by cyanidation, but idle since 1923, continued development work.

Texas

METAL mines in Texas in 1929 produced, in terms of recovered metals, $28,000 in gold, 1,050,000 ounces of silver, 1,000,000 pounds of lead, and 400,000 pounds of copper. This compares with a 1928 production of $10,115 in gold, 1,340,622 ounces of silver, 695,570 pounds of lead, and 447,792 pounds of copper, indicating an increase in the output of gold and lead and a decrease in the output of silver and copper. The Presidio mine, at Shafter, Presidio County, operated since April, 1926, by the American Metal Company, contributed the greater part of the state's production.

The El Paso Smelting Works, at El Paso, continued to operate its lead plant on ores from Mexico, New Mexico, Arizona, and Texas, and its copper plant on ores and concentrates from Arizona, New Mexico, and Texas. During 1929, at El Paso, the Nichols Copper Company constructed a 100,000-ton electrolytic copper refinery, which will be started early in 1930.

Utah

THE mines of Utah in 1929 produced gold, silver, copper, lead, and zinc valued at about $96,485,000, an increase of about $17,226,000 over the output of 1928. A large increase was reported in copper and gold on account of vigorous mining and improvements at Bingham, especially during the first half of the year. Good increases were also reported in the production of silver and zinc, but the output of lead was slightly less than that of 1928. The production of copper in 1929, was the largest that has ever been recorded in Utah, leaving no doubt that the state has established itself as the second copper producer of the United States.

Utah remained first in the United States in the production of silver, second in copper after Arizona, and third in lead after Missouri and Idaho.

The dividends reported paid by mining companies in Utah in 1929, the largest aggregate payments ever reported in the state, amounted to about $38,045,070, exclusive of $3,313,409 paid by the United States Smelting, Refining & Mining Company, which controls mines at Eureka and Bingham, as well as mines in other states.

The gold production increased considerably from $4,394,001 in 1928 to about $4,803,000 in 1929.

The silver output increased from 17,072,852 ounces in 1928 to about 17,749,000 ounces in 1929, and the production was about 4,499,000 ounces more than that of Montana, which was second in silver production in the United States. The value of the silver output decreased from $9,987,618 to about $9,478,000.

Copper increased from 293,235,039 pounds in 1928 to about 320,193,000 pounds in 1929, the largest production ever recorded from the state. The value increased from $42,225,846 to about $57,314,000 as a result of the increased price of copper and intensive work at Bingham. Utah ranked second in copper production in 1929 after Arizona and was followed by Montana.

The lead output decreased from 291,830,021 pounds in 1928 to about 286,817,000 pounds in 1929, but the value increased from $16,926,141 to about $18,213,000 on account of the higher average price of lead.

The zinc, recovered chiefly from concentrate leached or smelted, increased from 93,857,352 pounds in 1928 to about 100,400,000 pounds in 1929.

In 1929 the mines of Utah produced about 19,857,000 tons of ore and old tailings, an increase from 18,427,117 tons in 1928. Of this total the Bingham district produced about 18,600,000 tons as compared with 17,251,706 tons in 1928. The estimated production of the district was 160,410 ounces of gold, 4,640,000 ounces of silver, 311,900,000 pounds of copper, 96,600,000 pounds of lead, and 43,600,000 pounds of zinc. The production in 1928 was 140,813.93 ounces of gold, 3,728,942 ounces of silver, 287,684,950 pounds of copper, 104,750,662 pounds of lead, and 44,492,643 pounds of zinc.

The mines of the Tintic district produced about 420,000 tons of ore and old tailings, as compared with 379,349 tons in 1928. The estimated production of the district was 42,000 ounces of gold, 6,130,000 ounces of silver, 2,800,000 pounds of copper, 85,600,000 pounds of lead, and 750,000 pounds of zinc. The production in 1928 was 34,406.80 ounces of gold, 6,232,602 ounces of silver, 2,456,896 pounds of copper, 88,192,591 pounds of lead, and 41,563 pounds of zinc.

Crude ore and old tailings produced by mines in the Park City region amounted to about 743,000 tons in 1929, as compared with 731,103 tons in 1928. The estimated output of the district was 21,800 ounces of gold, 6,420,000 ounces of silver, 3,000,000 pounds of copper, 84,700,000 pounds of lead, and 53,150,000 pounds of zinc. In 1928 the Park City region produced 26,234.16 ounces of gold, 6,745,826 ounces of silver, 2,639,492 pounds of copper, 82,854,090 pounds of lead, and 47,569,849 pounds of zinc.

Washington

THE value of the gold, silver, copper, lead, and zinc produced from ore mined in the state of Washington in 1929 was about $465,438 as compared with $633,156 in 1928. There was an increase in the quantity of recovered copper and a large increase in zinc, but decreases were reported in the output of gold, silver, and lead. The production of gold decreased abnormally from $337,167 in 1928 to about $74,600 in 1929.

The output of silver in the state decreased from 99,738 ounces in 1928 to about 29,600 ounces in 1929.

The output of copper increased slightly from 1,177,246 pounds in 1928 to about 1,252,000 pounds in 1929, and the value from $169,523 to about $224,100.

The output of lead decreased from 1,084,739 pounds, valued at $62,915 in 1928, to about 813,000 pounds, valued at $51,600 in 1929.

The production of zinc increased from 85,318 pounds in 1928 to about 1,493,000 pounds in 1929, due chiefly to work near Metaline Falls.

THE COPPER INDUSTRY IN 1929

MANY records were broken by the copper industry in 1929, according to the United States Bureau of Mines. Domestic withdrawals which assumed record-breaking proportions in the fall of 1928 continued at a high rate and for the year 1929 were higher than ever before, even than during the war years. Copper prices rose from a monthly average of 13.9 cents a pound in January, 1928, to 15.9 cents in December, and continued the rapid advance to a high of 23.775 cents a pound, at refinery, March 23, 1929, where it held until April 5. From April 5 to April 15 the price dropped to 17.775 cents a pound, where it has remained up to the present time. Heavy demand followed by increased prices brought forth the highest smelter and refinery production on record. The heavy demand in the fall of 1928 drew heavily on stocks of refined copper and at the end of the year only 114,000,000 pounds were in stock, while the largely increased production during that period made itself apparent in blister stocks which were larger than at the end of 1927. Production has been sufficiently ahead of withdrawals in 1929 for stocks of refined copper to much more than double during the year. Curtailed production at the mines and smelters during the last quarter of 1929 has been apparent first in blister stocks again and these are estimated by producers to have increased only about 5 percent. The estimated smelter production from domestic ores for December, 1929, as reported by the smelters, was 146,000,000 pounds, 25,000,000 pounds lower than the average for the 11 months preceding. Imports of copper during the first 11 months of 1929 were considerably in excess of imports during any previous calendar year. Exports of metallic copper will probably show a decrease of 120,000,000 pounds for the year.

The smelter production of copper from domestic ores in 1929 as determined by the Bureau of Mines from reports of the smelters showing actual production for 11 months and estimated production for December, was 2,030,000,000 pounds, compared with 1,826,000,000 pounds in 1928. The 1929 production is 11 percent higher than that of 1928, and is the largest production on record. The estimated smelter production from domestic ores for December as reported by the smelters, was 146,000,000 pounds, which is 25,000,000 pounds lower than the average for the 11 months preceding and compares with an estimate of 179,000,000 pounds for December, 1928.

The production of new refined copper from domestic sources, determined in the same manner as smelter production, was about 2,022,000,000 pounds, compared with 1,792,000,000 pounds in 1928. In 1929 the production of new refined copper from domestic and foreign sources amounted to about 2,772,000,000 pounds, compared with 2,488,000,000 pounds in 1928, an increase of 284,000,000 pounds or 11 percent. The production of secondary copper by primary refineries increased from 232,000,000 pounds to about 308,000,000 pounds in 1929, or 76,000,000 pounds, so that the total primary and secondary output of copper by the refineries was 13 percent higher in 1929 than in 1928, being about 3,080,000,000

pounds compared with 2,720,000,000 pounds.

The imports of unmanufactured copper during the first 11 months of 1929, according to the Bureau of Foreign and Domestic Commerce, amounted to 905,912,237 pounds, a monthly rate of 82,000,000 pounds compared with 787,073,640 pounds for the entire year of 1928, a monthly rate of 66,000,000 pounds. The total imports for 1929 will very likely show an increase in quantity of approximately 200,000,000 pounds for the year, approximately 25 percent.

The exports of metallic copper during the first 11 months of 1929 amounted to 933,255,654 pounds, compared with 1,121,186,640 pounds exported during the entire year 1928. If the exports of metallic copper in December equal the monthly average for the first 11 months of the year, nearly 85,000,000 pounds, the total for 1929 will be about 1,018,000,000 pounds. Exports in November, however, amounted to only 56,800,000 pounds and it is unlikely that those for December will be near the average for the year. Exports for the year, therefore, will probably not exceed 1,000,000,000 pounds. In the first 11 months of 1929, 849,195,117 pounds of refined copper in ingots, bars, rods and other forms, were exported. Of this quantity the United Kingdom received 194,671,328 pounds, the highest amount, Germany was next with 168,531,203 pounds, and France was third with 155,488,031 pounds. In the entire year 1928 the United Kingdom received the largest amount, 212,771,665 pounds. Germany was next with 206,583,503 pounds and France was third with 172,607,211 pounds. When figures for December are added, exports to Germany will show a decrease of more than 10 percent, those to the United Kingdom may decrease slightly, and those to France will probably show a decrease of about 5 percent.

Refineries report that at the end of 1929 approximately 265,000,000 pounds of refined copper would be in stock, considerably more than double the 114,000,000 pounds at the end of 1928. It is estimated that stocks of blister copper at the smelters, in transit to refineries, and at refineries, and materials in process of refining, would be about 443,000,000 pounds on December 31, compared with 423,000,000 pounds at the end of 1928, an increase of 20,000,000 pounds. Therefore, an increase of 171,000,000 pounds in total smelter and refinery stocks is indicated.

The quantity of new refined copper withdrawn on domestic account during the year was about 1,849,000,000 pounds, compared with 1,609,000,000 pounds in 1928, an increase of 240,000,000 pounds or nearly 15 percent, and were the highest ever recorded.

LEAD AND ZINC IN 1929

Lead

THE recoverable lead contained in ore mined in the United States in 1929, exclusive of Virginia, was about 647,500 short tons, as compared with an output of 627,153 tons in 1928, an increase of 3 percent, according to the Bureau of Mines figures. The largest output came from the Southeastern Missouri district and amounted to 201,700 tons, compared with 194,270 tons in 1928. The race between Idaho and Utah for second place has been very close for the past two years, but Idaho definitely lead Utah in 1929 with 152,100 tons compared with 143,400 tons. In 1928 these states produced 145,323 tons and 145,915 tons with Utah slightly in the lead. The output of the Joplin district increased from 70,086 tons to 73,500 tons in 1929 and the production of all other important lead-producing states, with the exception of Colorado, increased. Colorado's production dropped from 26,751 tons to 24,900 tons.

The price at Joplin of lead concentrates was $85 a ton at the beginning of the year, rose to a high of $105 a ton for the weeks of March 23 and March 30, from which it declined to $85 a ton for the weeks of July 13 to August 31, inclusive, rose again to $87.50 a ton for the weeks of September 7 to October 26, inclusive, and then declined to $75 a ton, the low for the year, which held during the last eight weeks of the year.

The output of primary domestic desilverized lead in 1929 was about 382,000 tons; of soft lead about 250,000 tons, and of desilverized soft lead about 57,000 tons, making a total output from domestic ores of about 689,000 tons of refined lead. Corresponding figures in 1928 were 351,734 tons of desilverized lead, 225,003 tons of soft lead, and 49,465 tons of desilverized soft lead, making a total of 626,202 tons. The output of lead smelted and refined from foreign ore and bullion was about 103,000 tons, as compared with 154,869 tons in 1928. The total primary lead smelted or refined in the United States in 1929 was thus about 792,000 tons, as compared with a total of 781,071 tons in 1928—an increase of about 1 percent. The output of primary antimonial lead in 1929 was about 26,000 tons as compared with 33,058 tons in 1928.

Exports of lead of domestic origin amounted to 18,839 tons, as compared with 14,202 tons exported in 1928. Exclusive of stocks of lead at smelters and refineries and estimating the amount of lead exported with benefit of drawback, for which figures are not available, it is calculated that the new supply of lead made available for consumption in 1929 was about 718,000 tons, as compared with 657,565 tons in 1928.

The average monthly quoted price for lead at New York was 6.65 cents a pound in January, rose rapidly to a high of 7.5 cents in March, and declined steadily to a low of 6.25 cents in December. The average quoted price for 1928 was 6.31 cents a pound. The average selling price of lead for 1928, as reported to the Bureau of Mines by producers, was 5.8 cents a pound.

Zinc

The recoverable zinc contained in ore mined in the United States in 1929 was about 731,300 tons, as compared with 695,170 tons in 1928, an increase of 5 percent. The mine production of zinc in 1929 is the largest on record with the exception of the production of 774,563 tons in 1916. The output of the Eastern States was about 153,100 tons, an increase of 6 percent over production in 1928, of the Central States about 321,000 tons, and of the Western States about 257,200 tons. These figures compare with 144,045 tons for the Eastern States in 1928, 319,089 tons for the Central States and 232,036 tons for the Western States. Production in the Joplin district increased from 297,020 tons in 1928 to 299,600 tons in 1929, approximately 1 percent. In all of the Western States except Colorado production was larger in 1929 than in 1928, the increase amounting to 59 percent in Idaho. Colorado recorded a decrease of 17 percent in 1929.

The price at Joplin of zinc concentrates was $40 a ton from the week ending May 19, 1928, to the week ending February 9, 1929. The price rose to $44 a ton for the weeks of March 30 to October 26, inclusive, then declined to close the year with an average of $36,56 for December.

MINE PRODUCTION OF LEAD AND ZINC IN THE UNITED STATES IN 1928 AND 1929, IN TERMS OF THE RECOVERED AND RECOVERABLE METAL CONTENT, IN SHORT TONS. (1929 ESTIMATED)

	Lead		Zinc	
	1928	1929	1928	1929
Eastern States	*	*	144,045	153,100
Central States:				
Tri-State district	70,086	73,500	297,020	299,600
Southeastern Missouri	194,270	201,700	3,457	3,700
Upper Mississippi Valley	1,706	1,600	18,434	17,700
Michigan	.....	.....	.....	.....
Other	454	800	178	9
	266,516	277,600	319,089	321,000
Western States:				
Arizona	7,190	7,800	639	1,200
California	946	600	.....	25
Colorado	26,751	24,900	35,731	29,700
Idaho	145,323	152,100	31,263	49,600
Montana	16,880	19,800	82,830	84,800
Nevada	7,874	8,200	3,398	7,000
New Mexico	7,805	11,000	31,203	34,000
Oregon	7	13	.....	.....
South Dakota	37	.....	.....	.....
Texas	348	500	.....	.....
Utah	145,915	143,400	46,929	50,200
Washington	542	400	43	700
Wyoming	.....	.....	.....	.....
	359,618	368,700	232,036	257,200
Alaska†	1,919	1,200	.....	.....
Total	‡627,153	‡647,500	695,170	731,300

* Bureau of Mines not at liberty to publish.
† Figures obtained from the Geological Survey, Department of the Interior.
‡ Exclusive of total for Virginia which Bureau of Mines is not at liberty to publish.

The output of primary metallic zinc from domestic ores in 1929 reported to the Bureau of Mines was about 610,700 tons and that from foreign ores was about 13,300 tons, a total of 624,000 tons, as compared with 591,525 tons from domestic ores and 11,056 tons from foreign ores, a total of 602,581 tons in 1928. In addition to the output of primary zinc there was an output of about 52,100 tons of redistilled secondary zinc, as compared with 48,666 tons in 1928, making a total supply of distilled and electrolytic zinc in 1929 of about 676,100 tons, composed of 235,700 tons of high grade and intermediate, 97,500 tons of select and brass special, and 342,900 tons of prime western zinc. Of the total output of primary zinc in 1929, 157,300 tons was electrolytic zinc distributed as follows: Montana, 138,200 tons; Idaho, 16,500 tons; and Illinois, 2,600 tons. The electrolytic zinc plant of the Evans-Wallower Lead Company at East St. Louis, Ill., was put into operation in September, 1929. One hundred and ten thousand tons of slab zinc was made in Pennsylvania, 111,000 tons in Illinois, 108,000 tons in Oklahoma, and the remainder in Arkansas, Indiana, Kansas, Texas and West Virginia.

The total number of retorts at the 21 zinc smelters that operated during all or a part of the year was about 107,500. Of that number about 62,200 were reported in operation at the end of November and 62,200 were expected to be in operation at the end of the year. At the end of 1928 there were 63,716 in operation at 19 plants.

The average monthly price of prime western zinc at St. Louis was 6.3 cents a pound in January, rose to 6.8 cents a pound in August and September and declined rapidly to 5.7 cents in December. The average quoted price for 1928 was 6.03 cents a pound. The average selling price of all grades of zinc in 1928 was 6.1 cents a pound.

PRELIMINARY REPORT OF THE MANGANESE SITUATION, 1929

THERE was an increase of about 30 percent in shipments of manganese ore containing 35 percent or more of metallic manganese from domestic mines in 1929, which totaled approximately 61,000 gross tons, valued at $1,926,000, as compared with 46,860 gross tons, valued at $1,214,853 in 1928, according to the Bureau of Mines. The shipments of metallurgical ore in 1929 amounted to about 48,000 gross tons, valued at $1,380,000, as compared with 31,430 gross tons, valued at $593,561 in 1928, while chemical ore shipments decreased from 15,430 gross tons, valued at $621,292 in 1928, to about 13,000 gross tons, valued at $546,000 in 1929.

The relatively large increase in 1929 was mainly due to the increased output from the plant of the Domestic Manganese and Development Co., at Butte, Mont. This company treated in its mill about 50,000 gross tons of rhodochrosite averaging 37.6 percent of manganese from which was produced about 30,000 gross tons of sinter averaging 57.7 percent of manganese. During 1928 this company treated about 18,600 tons of crude ore containing 37 percent of manganese, and obtained 11,118 gross tons of nodulized product averaging 57 percent of manganese. Chemical ore shipments from Philipsburg amounted to 12,800 gross tons in 1929, as compared with 14,689 tons in 1928. Shipments of high-grade ore from Arkansas were about 3,600 tons as in 1928; Arizona shipments decreased from 3,507 gross tons in 1928 to about 2,600 tons in 1929; Georgia shipments likewise decreased from 4,727 tons in 1928 to 2,500 tons in 1929; Idaho showed little change; New Mexico shipments increased from 2,627 tons in 1928 to about 2,900 tons in 1929. Tennessee shipments showed a marked increase from 55 tons in 1928 to over 500 tons in 1929, while Virginia's decreased slightly.

Figures furnished by the Bureau of Foreign and Domestic Commerce show that during the first 11 months of 1929 the United States imported 630,083 gross tons of ore containing 308,113 gross tons of metallic manganese. Assuming that the imports for December were at the same rate as in November, the total tonnage imported would be approximately 680,000 gross tons containing 332,000 gross tons of metallic manganese, as compared with 427,708 gross tons of ore containing 207,808 tons of metallic manganese during 1928. The imports from Soviet Russia for the first 11 months amounted to 328,861 gross tons of ore containing 168,874 gross tons of metallic manganese, compared with 159,842 gross tons containing 79,529 tons of metallic manganese in the entire year of 1928; Brazil furnished 194,335 tons containing 84,569 gross tons of metallic manganese during the first 11 months of 1929 as compared with 142,300 gross tons containing 64,290 gross tons of metallic manganese during all of 1928; imports received from India amounted to 67,440 gross tons containing about 34,619 tons of manganese during the first 11 months of 1929, as compared with 83,600 tons containing 43,072 tons of metallic manganese in 1928; while British West Africa (Gold Coast) furnished 27,587 gross tons of ore containing 13,258 tons of metallic manganese for the first 11 months of 1929, as compared with 24,186 tons containing 11,712 tons of metallic manganese for the entire year of 1928. The increased (over double) importation from Soviet Russia is worthy of note.

For the first 11 months of 1929 the manganese content of ferro-manganese imported was 58,956 tons as compared with 48,844 tons for the entire year 1928. The imports for the entire year 1929 are estimated at 63,600 tons of manganese content, equivalent to 79,500 tons of ferro-manganese, or 150,000 tons of ore.

There was a record production of steel in 1929, estimated at 56,100,000 tons of ingots and castings, compared with 51,544,180 tons in 1928, and a consequent demand for ferro-manganese and in turn for manganese ore. The estimated production of ferro-manganese in 1929 is given in the Iron Trade Review of January 2, 1930, as 333,800 tons, the largest output on record, compared with 319,770 tons in 1928. The rate of consumption of manganese ore in the manufacture of ferro-manganese, as reported for 1928 by ferro-manganese producers was 1.891 tons of ore per ton of product. At this rate the production of ferro-manganese in 1929 would have required about 631,000 tons of ore. For this purpose the supply was ample: namely 60,000 tons of domestic high-grade ore plus 680,000 tons of imported ore minus about 45,000 to 50,000 tons diverted for "chemical" uses, a balance of 690,000 to 695,000 tons.

About 63,600 tons of ferro-manganese, equivalent to 150,000 tons of ore (figured on the same percentage of recovery as in domestic manufacture) was imported for consumption in 1929. This figure added to the requirements of domestic ferro-manganese producers (631,000 tons) would indicate that the total metallurgical requirement in the United States in 1929 was probably in the neighborhood of 781,000 tons.

The shipments of domestic ore containing from 10 to 35 percent of manganese (ferruginous manganese ore) in 1929 were 77,000 gross tons, valued at approximately $419,000, as compared with 90,581 tons, valued at $407,289 in 1928. The domestic shipments of ore containing from 5 to 10 percent of manganese (manganiferous iron ore) in 1929 were 1,100,000 tons, valued at $2,772,000, as compared with 1,085,401 tons, valued at $2,645,145 in 1928.

COMPLEX ORE INVESTIGATIONS

Microscopic investigations of complex ores conducted at the Intermountain Experiment Station of the Bureau of Mines, Salt Lake City, in cooperation with the University of Utah, show that the microscope has an almost unlimited field of application to the various phases of ore-dressing problems. During the progress of this work, the microscope has been applied as a fact-finding instrument to determine the mineralogical and other physical characteristics of numerous complex sulphide and oxide ores. Since the amenability of these ores to flotation or other treatment depends primarily upon a knowledge on the part of the operator of their physical structure, the data supplied by the microscope are invaluable.

GEOLOGICAL SURVEY REPORTS ON MANGANESE-IRON CARBONATE DEPOSIT IN SOUTH DAKOTA

A report on Manganese-Iron Carbonate near Chamberlain, S. Dak., has been issued by the U. S. Geological Survey. Explorations under private auspices during 1928 and 1929 have shown the presence of a bed of shale containing manganiferous iron carbonate nodules for many miles along the valley of the Missouri River in south-central South Dakota. On the basis of the record of this exploratory work, a preliminary examination of the central part of the area was made by D. F. Hewett, a geologist of the Geological Survey, Department of the Interior, in July, 1929. The explorations adequately demonstrate the existence over many square miles of a horizontal bed 38 feet thick, which will give an average yield per cubic yard of 164 pounds of nodules having a manganese content of about 25 pounds. The Survey states, however, that in view of the unusual character of this material and the lack of demonstrated methods of treatment it does not seem justifiable at present to include the material in estimates of national reserves of manganiferous ores.

Stockholders Approve Mining Subsidiary of Eagle-Picher

The stockholders of the Eagle-Picher Lead Company, at a special meeting January 23, approved the recommendation of the board of directors for the creation of a company to be operated as a subsidiary of the Eagle-Picher Lead Company and to be known as the Eagle-Picher Mining and Smelting Company.

The mining properties and leases of the Eagle-Picher Lead Company in the Tri-State district; the lead smelter at Galena, Kans., and zinc smelter and gas and oil properties at Henryetta, Okla., will be transferred to the new company.

Commerce Largest Tri-State Zinc-Lead Shipper

The Commerce Mining and Royalty Company topped the lead and zinc shippers of the Tri-State district in 1929 for the third consecutive year. It shipped 46,778 tons of zinc and 17,378 tons of lead in 1929, as compared with 56,381 tons of zinc and 12,267 tons of lead in 1928.

The Century Zinc Company was second in both lead and zinc shipments in 1929. In 1928 the Century was sixth in zinc and second in lead shipments. The Century shipped 36,010 tons of zinc and 7,621 tons of lead in 1929, as compared with 27,562 tons of zinc and 8,802 tons of lead in 1928.

Third place this year was taken by the Federal Mining and Smelting Company, which in 1928 finished in second place. The Federal's deliveries dropped to 32,953 tons in 1929, as compared with 41,000 tons in the previous year.

Fourth place was taken by the Eagle-Picher Lead Company, which in the previous year finished third. Just back of the Eagle-Picher, in fifth place, was its subsidiary, the Consolidated Lead and Zinc Company.

Thirty-three companies shipped more than 5,000 tons of zinc in 1929, as against 32 in the previous year.

Tally Elected President of United Verde

R. E. Tally, President of the American Mining Congress, has been elected president of United Verde Copper Company to take place of C. W. Clark, who became chairman of board, a new office. J. W. Hall, Jr., was elected secretary.

Cleveland-Cliffs to Operate Donner Company Mines

The Cleveland-Cliffs Company will operate properties of the Donner Iron Mining Company during the 1930 season, according to information given by officials.

The result of the changing of management is due to the consolidating of five large steel and mining companies through the efforts of Cyrus Eaton, noted Cleveland financier. Companies affected by the merger include: Republic Iron & Steel Company, Central Alloy Steel Company, Bourne-Fuller Company, and Trumbull-Cliffs Furnace Company.

Hanna Mines Ore Safely

M. A. Hanna Co., Cleveland, operating extensive ore mining properties on the Minnesota and Michigan ranges, has added to its record of safe mining. To December 1, the Homer and Richmond mines completed 23 consecutive months without a lost-time accident. The South Uno mine extended its record to 16 months and the Maroco mine to 13 months.

Wilbur Mine Wins Tri-State Safety Contest

The 1929 accident prevention contest in the Tri-State District was won by the Wilbur mine of the Commerce Mining and Royalty Company, which had the best accident record of any mine during the year.

Employes of the Wilbur mine worked 22,035 man-shifts during the year and mined 131,868 tons of ore without suffering a single lost-time accident. The mine reported only 24 minor no-lost-time accidents.

Three other mines of the Commerce company worked through the year without a lost-time accident, according to a report made by Henry Giessing, safety engineer. The Beaver employes worked 11,518 man-shifts and mined 70,725 tons of ore without a lost-time accident and reported 19 no-lost-time accidents. The Jaybird employes worked 12,845 man-shifts, mined 99,691 tons of ore and reported only 20 no-lost-time accidents. The Gosling tailing mill employes worked 1,667 man-shifts without a lost-time accident, handled 5,136 tons of tailings and reported only four no-lost-time accidents.

Five of the company's mines, the Webber, West Side, Grace Walker, Scammon Hill and Mary Ann, reported only one lost-time accident each.

The Central mine had five lost-time accidents, the Blue Goose six and the Paxson 18.

The one accident at the Grace Walker mine was credited as a lost-time accident, but the employe did not lose any time. He was paid compensation, however.

The Commerce company suffered only one fatal accident. An employe lost his life at the Bird Dog mine, which is in a state of development, when a rock fell down the shaft.

Fire At Tacoma Smelter

Fire of undertermined origin that swept through a refining unit of the Tacoma plant of the American Smelting & Refining Company on January 12, did damage estimated at $100,000, according to E. A. White, superintendent. The fire started in one end of the basement of the one-story tile structure and swept to the roof. Before it was brought under control half the roof was burned off and much of the equipment damaged. Copper production at the smelter will be cut 50 per cent as a result of the fire.

Mining Ore in Open Stopes

Data regarding mining methods and costs obtained from 20 mines using open-stope methods in the Central and Eastern states are correlated and summarized in Information Circular 6193, by Chas. F. Jackson, recently published by the Bureau of Mines. The term "open-stopes" as employed by the Bureau is applied to all naturally supported stopes; that is, stopes in which the excavated ore is not replaced by support of an artificial nature other than props or stulls and in which the ore or (and) capping are not caved during the active life of the stopes.

The report discusses limitations and variations of open-stope methods; applications of open-stope methods in various mining districts; drilling, blasting, and handling and loading practice; underground costs and stoping costs; pounds of explosive used per ton of ore broken, and figures on power consumption.

Michigan College of Mining and Technology Metallurgical Awards

Corbin T. Eddy, physical metallurgist, has been awarded first place for outstanding work in metallurgical research for the year 1929 at the Michigan College of Mining and Technology. The award was made by a committee consisting of President W. O. Hotchkiss, Prof. A. T. Sweet, head of the department of metallurgy, and Assistant Prof. N. H. Manderfield, of metallurgy.

Roy W. Drier and Frank Tolonen, research assistants in the department of metallurgy, received honorable mention. Mr. Drier contributed valuable research in X-ray and photo electric work and Mr. Tolonen in iron ore research.

Mr. Eddy was awarded first place in metallurgical research for his participation in three major projects. His major work was in the refining of copper with a comprehensive study of the effects and the elimination of impurities, such as arsenic, silver, iron and sulphur. He also did valuable work on decomposition temperatures of various sulphates, giving particular study to the formation and decomposition of sulphate of manganese.

M. R. Evans Dies—Utah Mining Pioneer

Morris R. Evans, pioneer Utah mining and business man, died of nephritis at his home in Salt Lake City December 29 at the age of 80. He was born at Lockport, N. Y., and had been a resident of Utah since 1871. He first engaged in the livestock business in the Uintah basin of eastern Utah and later conducted a mercantile business in Salt Lake City for many years. He was active in the development of many metal mining properties of the state and was also a patron of sports. He was a member of several local civic and social organizations, vice president of the Hollywood, Calif., Baseball Club, an active member of the American Mining Congress and a former director of its Utah Chapter. He leaves a widow and six children.

Committee to Study Stabilization of Mineral Production

A study designed to check the present waste of mineral resources due to overproduction in the industry has been initiated by the American Mining Congress. This action was taken at a meeting of the Board of Directors in accordance with a resolution adopted at its convention in Washington, D. C., in December. The investigation will be conducted by the following committee representing the various branches of the mining industry.

Clinton H. Crane of the St. Joseph Lead Co., of New York; Ralph M. Roosevelt of the American Zinc Institute of New York; C. E. Bockus of the National Coal Association of New York; F. H. Brownell of the American Smelting and Refining Co., of New York; S. L. Mather of the Cleveland-Cliffs Iron Co., of Cleveland; S. D. Warriner of the Lehigh Coal and Navigation Company of Philadelphia and E. B. Reeser of the American Petroleum Institute of Tulsa.

In addition to a study of the waste of the mineral resources, the committee will survey the situation in relation to the waste of capital and labor involved in such over-production. The entire situation as to the evils of over-production and the hurried exhaustion of the natural resources of the country will be gone into. The difficulty of meeting the situation due to restrictions under the anti-trust laws will be studied and an attempt made to seek a solution of the problem in order that the natural resources shall be conserved and mining placed on a more sound and business-like basis. The meeting of the Board of Directors at which this action was taken was held in New York on January 3, at which there was a general discussion of the situation and of possible plans by which a solution of the problem could be reached.

H. H. Stout Resigns Phelps Dodge Position

Colonel H. H. Stout, for many years superintendent of the Copper Queen smelter, has resigned as consulting metallurgist for the Phelps Dodge corporation, a position to which he was promoted when he left the Douglas smelter, and will enter independent consulting work, according to an announcement made from the office of Walter Douglas, president of the Phelps Dodge Corporation. The resignation was effective January 1, this year.

Colonel Stout will continue as consulting engineer for the Phelps Dodge Corporation, but his duties will permit him to devote considerable time to independent work.

Cleveland-Cliffs Adopts New Bonus System for Ishpeming District

The Cleveland-Cliffs Iron Company has established an annual record in safety work at its mines in the Ishpeming district during the past few years. S. R. Elliott, general manager, has worked out a new system, to be known as the "safety bonus" plan, which, it is thought, will help cut down lost time by employes as a result of accidents. The plan was first applied to shift bosses and now captains of the various properties are to be included. The order applies to underground and surface bosses, with the former receiving extra pay on a percentage plan, based on the earnings of contract miners, while surface bosses will be paid a flat rate of 35 cents a day.

Three of the mining captains who will work under the new plan will change places on the first of February and it is planned to shift captains to different mines from time to time.

During the first period the bonus system was in effect there was not a single lost-time accident, so that all the company's bosses shared in the distribution of extra funds.

Third Large Manganese Plant Starts Production

The new manganese ore concentrating plant of the Hy-Grade Manganese Production & Sales Corp., at Woodstock, Va., has just been completed and thrown into production.

Development of the Hy-Grade mine has has been carried on for the past eight years and construction of the milling plant has been underway for the past 12 months, representing an expenditure of several hundred thousand dollars.

The plant has a capacity of 30,000 tons of ferro-grade manganese ore per year. The ore will be shipped to ferromanganese manufacturers and steel mills in the East.

This is the third large domestic manganese plant to go into production in recent months. The other two are the plants of the Domestic Manganese & Development Co., Butte, Mont., and the Georgia Manganese & Iron Co., White, Ga.

The potential capacity of these three plants combined exceeds 200,000 tons of ferro-grade manganese ore per year.

Mining Securities Exchange is Planned

Formation of a new exchange to be known as the New York Mining Exchange is announced by counsel for a group of brokers to whom the secretary of the State of New York recently granted a charter for the new organization. The exchange is being formed for the purpose of providing a market for mining and oil securities.

The establishing of a New York trading center will bring into the market more than $500,000,000 in securities the organizers claim, which heretofore have had to be financed through private channels.

In addition to the listing of new securities tentative arrangements have been made for the listing of 150 issues which are now being traded in on other exchanges. The new exchange will cooperate with existing mining exchanges throughout the United States, Canada and Mexico.

Phelps Dodge Begins Three-Year Study of Morenci Ores

The Phelps Dodge corporation, Morenci branch, has opened an office in the old Arizona Copper Company building at Clifton, Ariz., which will be used by a number of specialists in a study of the low-grade ores in this district. The survey will carry over a period of three years, according to Frank Ayer, manager of the Morenci branch.

C. Legrand will be in charge of the work. A number of experiments will be made with the ores and plans have been made for the construction of a milling plant to be used in carrying on the tests. Another early development in the program will be the construction of a tunnel from the mines to the site of the new concentration plant.

In the test mill, to be located at a point near Bunkers, just west of Morenci, the specialists will determine the best methods for the handling of ore. The study will be a thorough one and will include treatment of the ores by chemicals as well as the many modern devices patented for recovery purposes.

Mr. Legrand, who is in charge of the work, has been with the Phelps Dodge Corporation for 25 years. He has been joined in directing the study of the ores by W. C. Capron, chief engineer of the project, who has been connected with the Anaconda Copper Company for a number of years.

It was pointed out that the present high-grade material in the mines of the Morenci branch are not expected to last for a great many years and the program is being launched at this time in order to prepare for the time when the Morenci mines must resort to recovery from the low-grade material.

There are many large deposits of the low-grade ore in the Morenci properties. It is believed that it will be necessary to handle these in great quantities in order to carry on production at a profit. The test mill when perfected will provide a model for the construction of a huge milling plant.

In carrying on the work all of the latest known devices will be employed in the search for the most economical scheme of operation.

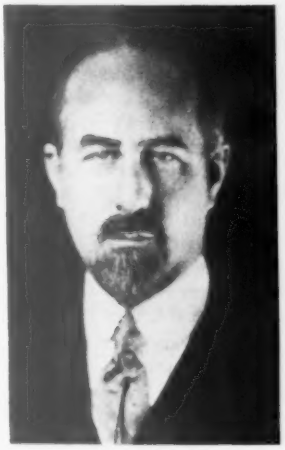
Lucien Eaton in London

Lucien Eaton, formerly of The Cleveland-Cliffs Iron Company at Ishpeming, Mich., sailed on January 10 for London, where he will be located with the Rhodesian Selection Trust, Farleigh House, 99 Cheapside London, E. C. 2.

Mr. Eaton spent considerable time in northern Rhodesia the latter part of 1929 in connection with his new duties and expects to be abroad until the latter part of April.

J. V. N. Dorr Awarded James Douglas Medal

John Van Nostrand Dorr, prominent metallurgical engineer and president of The Dorr Company, Engineers, has been awarded the James Douglas Medal of the American Institute of Mining and Metallurgical Engineers in recognition, according to the citation, "of his invention of apparatus and achievement in developing and improving hydrometallurgical practice." This medal, awarded annually for distinguished service in non-ferrous



John Van Nostrand Dorr

metallurgy, commemorates Dr. James Douglas, twice president of the A. I. M. E. and founder of the Phelps Dodge enterprise, and will be presented formally at the annual convention of the institute in New York in February, 1930.

Mr. Dorr, after an early association with Thomas A. Edison, graduated from Rutgers University and became engaged in metallurgy in the Black Hills of South Dakota and in Colorado, first as a metallurgical chemist, later as managing partner of a gold mine and then as a consultant. It was during this period that he invented the classified, thickener, and agitator which bear his name, the use of which has since become virtually standard in the treatment of metalliferous ores and in many branches of chemical, industrial and sanitary practice.

The development of the equipment early invented by Mr. Dorr and the investigations necessary to utilize it to the best advantage in the many industries whose practices have subsequently been improved through its use, led to the building up of an international industrial organization with branches and affiliations in all parts of the world. Mr. Dorr is president of the Dorr Co., Inc., of the United States, and the head of associated companies in London, Paris, and Berlin, and has established representation in South Africa, Australia, and Japan.

In 1916 Mr. Dorr was the recipient of the John Scott medal of the Franklin Institute for his invention of hydrometallurgical apparatus used extensively in the cyanide process. Rutgers University, which Mr. Dorr has long served as a trustee, in 1927 conferred upon him the honorary degree of Doctor of Science "in consideration of his important contributions to the metallurgical and chemical industries."

Mr. Dorr has been actively identified with the professional societies of those engineering groups with whom he enjoyed a lifelong association. He recently (December 12) returned from Japan, where he served as delegate of the A. I. M. E. to the World's Engineering Congress in Tokyo and expects to leave for South Africa the latter part of February to attend the meeting in Capetown of the Empire Mining and Metallurgical Congress.

Phelps Dodge Safety Contest Won by Morenci Branch

With only six time-lost accidents for the entire year, the Morenci branch of the Phelps Dodge Corporation was awarded first honors in the company's safety contest for the year of 1929. Several perfect records were turned in for a month's period during the year.

A total of only 116 time-lost accidents were reported from the five branches of the corporation during 1921—a remarkable record considering the great number of men employed.

The Moctezuma branch, of Nacozeri, Mexico, winner of the 1928 contest, was runner-up with 24 accidents. The Old Dominion branch of Globe was in third place with 11 time-lost accidents, and the Copper Queen branch took fourth place with 49 accidents. The Stag Canyon branch had 26 time-lost accidents and finished in last place.

Figured on the basis of 1,000 shifts worked, the rating of the Morenci branch for the year was .013; the Moctezuma, .038; the Old Dominion, .042; the Copper Queen, .043; and the Stag Canyon, .113.

The Morenci branch finished up the year by leading in safety competition for the final month, December

British Columbia Mineral Production for 1929 May Set Record

Preliminary reports released by the provincial minister of mines estimate that the gross value of the mineral production of British Columbia for 1929 will set a new high record, the approximate figures being $70,030,776, an increase of $4,658,393 over last year.

For the first time copper production exceeded 100,000,000 pounds, and lead also showed an increase, but there was a decline of more than $1,000,000 in the value of the output of coal mines.

Arizona Mine Accidents Show Decrease in 1929

There were 32 fatal mine accidents in Arizona in 1929, the smallest in the state's history, according to the annual report of Tom C. Foster, state mine inspector, submitted to Governor J. C. Phillips.

Despite the fact that there were more men working in the mines than at any time since peak production was reached during the World War, deaths resulting from accidents was very low, the report shows.

According to the report 3,000 more men drew mining wages in 1929 than in 1928.

The report shows that of the 14,459 men employed in 1929, 11,499 were underground workers with 3,030 surface employes.

Canada's Mine Output

In 1929, for the fourth successive year, the mining industry of Canada recorded a new high record output, valued at $303,876,000, or 10.5 per cent more than in the preceding year, according to the official estimate of S. J. Cook, chief of the mining, metallurgical and chemical branch of the Dominion Bureau of Statistics. During the year new records were made in the output of asbestos, cement, clay products, copper, gold, gypsum, lime, nickel, petroleum, salt, stone, sand and gravel, zinc and in the value of natural gas. The increase in the value of the mineral output in 1929 over 1928 was $28,887,000.

Beneficiation of Missouri Iron Ores

A study of the beneficiation of Missouri iron ores is being conducted by the Mississippi Valley Experiment Station of the Bureau of Mines in cooperation with the Missouri School of Mines and Metallurgy, Rolla, Mo. One of these ores, with unusually clean grains of hematite but accompanied by too many heavy minerals, such as garnet, to yield good results by gravity concentration, has been given a reducing roast and magnetic log washing. The best grade of concentrate expected by gravity concentration would be about 52 per cent iron and 15 per cent silica, whereas the magnetic log-washer gave a concentrate with a tenor of 68 per cent iron and 3 per cent silica. The recovery in a commercial magnetic log-washer would be about 93 per cent. It cannot be stated now whether the new process would add to a company's revenue but the technical advantages are obvious. The scarcity of ores with clean mineral grains is increasing so that they are difficult to find. Their conservation should be encouraged, says the Bureau.

Colorado Mining Organizations Hold Annual Meeting in Denver

More than 300 mining men attended the annual joint meeting of the Colorado Mining Association and the Colorado Chapter of the American Mining Congress, January 21 and 22.

The mining organizations in Colorado, including the Colorado Metal Fund Association, have had a prosperous and successful year, according to statements made in the annual reports of President Jesse F. McDonald, Secretary C. Lorimer Colburn and Treasurer A. M. Collins. Membership has increased to a considerable extent.

Safety in metal mines in Colorado and the prevention of accidents was discussed in a paper by E. H. Denny, district engineer for the United States Bureau of Mines who said that in the nine-year period from 1919 to 1927, inclusive, 153 metal miners were killed in this state and 5,035 workers incurred injuries causing loss of time. The loss to the industry in nine years would total more than six million dollars, Mr. Denny declared.

After two years of work the special committee appointed to investigate ore possibilities in the Denver area made an exhaustive report showing that in the counties of Boulder, Clear Creek, Gilpin, Park, and Summit, the possible ore production is not less than 2,500 tons daily, with values ranging from $8 to $12 per ton. Colorado now has a large number of concentrating plants in operation, but its 400 tons of zinc concentrates daily must be shipped out of the state, and the crying need of the industry is an electrolitic zinc plant in Denver or Pueblo, according to the conclusions of the special committee, and of the officers of the association, including President McDonald.

The special committee on investigation which has done an immense amount of work at practically no cost to the state or association, was composed of John T. Joyce state mine commissioner, chairman; R. J. Walter, J. O. A. Carper, John R. Wolff, A. E. Moynahan, W. L. Patrick, and R. M. Henderson.

Addresses were made on the public lands by Clay Tallman and Charles J. Moynahan, and D. D. Potter dealt with recent court decisions regarding oil shale claims and titles. The "Sowbelly Dinner," on the evening of January 22, witnessed an overflow attendance.

"Copper's Service To Industry"

Copper's role in meeting the increased demand for machinery and for manufacturing materials, resulting from the application of power to industry, is described in a special issue of the bulletin of the Copper and Brass Research Association, issued today, featuring "Copper's Service to Industry."

"Copper's part in manufacturing is not always evident to the consumer," the bulletin states, "for some industries employ the metal in making products which do not themselves contain it." An example is the printed page, the type for which is usually cast automatically from brass matrices. About 500,000,000 of these brass matrices are in service today in newspaper and general printing plants throughout the world.

"Seventy-five percent of American industry is now electrified. Hence, before an ounce of copper is consumed either as mechanical equipment or as parts for products, the average industry is already employing copper for the transmission and use of power and frequently also for its generation."

According to the bulletin, one of the leading clock and watch manufacturers alone consumes about 1,150,000 pounds of brass annually. A single rapid transit system in New York requires 650,000 pounds of copper, brass and bronze each year for service use, in addition to more than 2,000,000 feet of copper wire and cable.

Gold Strike Near Kingman, Ariz.

Much interest is being centered in the recent gold strike made in the Mohave Mountains, near Kingman, Ariz. It was reported that samples of ore showing values running as high as $96,000 a ton were found. While recent storms have hampered travel conditions to the new district, about 65 miles southwest of Kingman, many persons have made the trip and a number of mining men have inspected the properties.

The reports returned from the strike district are to the effect that there is a section of the country about a mile long and a half-mile wide through which there is a run of several parallel veins with a number of smaller veins joining and forming a net-like system.

Three prospectors located the ore veins during a prospecting trip in the district. Samples of the ore were taken and specimens of quartz in which free gold was easily discernible were found. The men staked out claims and began a system of prospecting which they declared gave them every reason to believe the property of value.

In the samples which were later assayed, showing returns running from $40,000 to $96,000 a ton, the men explained that they had selected the finest of the specimens.

While no definite plans have been announced by the men interested in the property at this time, it is known that they are planning an extensive development program throughout the district.

Mining Congress Southern Division to Meet at Little Rock March 10-12

Coordination of the industrial development of the South in the future based on a review of the industrial progress in each state, will be the principal objective of the Fifth Annual Industrial Development Conference of the Southern Division of the American Mining Congress to be held at Little Rock, Ark., March 10 to 12, inclusive, for which plans are now being made with a record attendance in view.

Included among the delegates from all southern states at the conference will be many governors or their alternates as well as leading industrialists, economists, financiers, scientists and engineers, who will give their views on matters of vital importance to the progress of the South as a whole.

A three-day program is being arranged for discussion on widely diversified lines including railroads, power companies, manufacturers and producers of raw materials, chambers of commerce, banks and investment houses, state geology and industry generally, and is expected to carry special significance to the Southern United States because of its scope and character.

Interest in the success of the conference due to the present business conditions of the country is expressed in a letter to the governors of southern states by Governor Pollard, of Virginia, who says: "In this age of rapid transportation, the availability of electric power and raw materials, and our strategic location with reference to markets in the east, make it necessary that we break down state boundaries and become sectionally minded in our industrial advancement. Under modern conditions state-mindedness is out of date."

This will be the first time that the conference has been carried west of the Mississippi River, the others having been held at Memphis, Birmingham, Gulfport and Atlanta.

On the night of March 10, visiting governors, Congressmen and officers of the American Mining Congress, will be entertained by Governor Parnell, of Arkansas, at a reception at the state executive mansion.

In addition to the regular business sessions, present plans call for a banquet on the evening of the eleventh, which will be radiocast over the Columbia network, and which includes among its entertainment features a male quartet and a special orchestra furnished by the Missouri Pacific Railroad. Also, a sightseeing trip to Hot Springs, Ark., is being arranged with stops at the Remmel Dam and Carpenter Dam, and a visit to the Niloak Pottery and Bauxite operations. A barbecue luncheon will be served enroute.

Robert E. Tally, of Clarkdale, Ariz., president of the United Verde Copper Mining Company and president of the American Mining Congress, is included in the list of speakers at the banquet, and Col. J. B. Reynolds, of Chicago, director of industrial development of the Midwest Utilities Company, and Herbert A. Brooks, manager of the Fort Harrison Hotel, of Clearwater, Fla., will be among the speakers at the business sessions of the conference.

NEAR SELL-OUT FOR CINCINNATI CONVENTION AND EXPOSITION

One hundred and two exhibitors have already secured space in the Cincinnati Music Hall for the National Exposition of Coal Mining Equipment of the American Mining Congress to be held in conjunction with the Seventh Annual Convention of Practical Coal Operating Men at Cincinnati, May 5 to 9, and 20,950 square feet of floor space have been sold. Notwithstanding, demands continue to come in for more room and a reply of "Standing Room Only" will have to be made at an early date. These facts indicate that the exposition will be the largest of its kind ever held.

The business program of the convention of operating men will include many subjects of vital importance to the industry and will be presented by men who are considered the leaders in their special fields.

It was decided at a recent meeting of the program committee held in Pittsburgh, that the following subjects would be given special consideration; a general review of conditions in the coal mining industry, mechanization, coal cleaning, coal preparation, personnel training, cost accounting, safety, transportation and maintenance. Special addresses on these topics will be followed by open discussions and a complete consideration of every detail is promised.

The Program Committee is headed by P. C. Thomas, general manager of mines for the Koppers Company.

Mine Fire Fighting Equipment Standards

Preventive measures, fire signals, and fire personnel as related to the mining industry are dealt with in a nine-page bulletin of revised standards and specifications just issued by the American Mining Congress and sponsored by them in conjunction with the National Fire Protection Association.

Subjects treated in this issue, and brought up to date, include: Fire Fighting Equipment, embracing water and water supply equipment for both surface and underground; Fire Extinguishers, fire pails and sprinkling systems, and oxygen breathing apparatus; Fire Preventative Measures, covering ventilation and ventilation equipment; Explosives and Electrical Equipment; and Fire Signals, Fire Fighting Personnel and Miscellaneous Measures.

In the latter classification are given important rules recommended to be followed in all mines when fire emergencies arise.

Senate to Take Another Vote on Countervailing Coal Duty

Senator Jones, Washington, has advised the Senate that he will ask for a reconsideration of the recent action of that body in striking out, at the request of the State Department, the countervailing provision in the tariff bill relating to coal, and it is likely that another vote on the matter will be taken in the near future.

The provision in question reads as follows: "Paragraph 1650. Coal, anthracite, semianthracite, bituminous, semibituminous, culm, slack, and shale; coke; compositions used for fuel in which coal or coal dust is the component material of chief value, whether in briquets or other form: Provided, That if any country, dependency, province, or other subdivision of government imposes a duty on any article specified in this paragraph, when imported from the United States, an equal duty shall be imposed upon such article coming into the United States from such country, dependency, province, or other subdivision of government."

Bell & Zoller Expands

Bell & Zoller Coal & Mining Company have been appointed to operate and handle the sales for the newly organized Crescent Mining Company, successor to the Crescent Coal Company, operating four mines in the Peoria, Ill., field. Mr. Faul Weir, vice president of Bell & Zoller, states production will be increased through modernization and the capacity of the Bell & Zoller properties will soon approximate 5,000,000 tons annually.

Polish-Britain Coal Agreement

An agreement has been reached between representatives of the coal industries of Poland and Great Britain with respect to cooperative action in foreign markets, it is announced by the American Polish Chamber of Commerce, on the basis of cable dispatches received from Warsaw.

The agreement, the first successfully negotiated in Europe with regard to coal, is hailed as an important step toward the stabilization of the European coal industry. The English delegation which participated in the negotiations represented five counties which produce an aggregate total of 100,000,000 tons of coal annually. The Polish delegation represented the entire Polish coal industry. It is anticipated that other British coal concerns will approve the terms of the agreement in the near future.

The significance of the agreement can be seen from the fact that Poland's coal production is exceeded in Europe only by England, Germany, and France. Moreover, on the basis of estimates as to the amount of coal available up to 1,000 meters in depth, it is pointed out, Poland is third in Europe, with Germany first and England second.

Under the terms of the agreement, an international committee will be instituted, with the two countries equally represented, this committee to meet at least four times a year. The first meeting is scheduled to be held in London on March 7. A special statistical information and control bureau, to be known as the International Coal Office, will be operated by the committee. In addition, two sub-committees will function, one to establish a common classification of coal from all English and Polish mines, the other to prepare the conditions of sales.

W. E. Davis Elected President of Hazard Coal Operators Exchange—J. H. Bowling Heads Coal Bureau

With better trade practices and every proper effort for higher realization as the keynotes, the Hazard Coal Operators' Exchange and the Hazard Coal Bureau held annual meetings January 31, closing with a banquet that evening at the Phoenix Hotel in Lexington, Ky. Reports showed the exchange to be in excellent condition financially and as to membership, and the trade bureau to be making progress in eliminating harmful trade practices and in bettering trade conditions. Following a talk by the chief of Kentucky's Department of Mines, John F. Daniel, provision was made for a continuation of the mine rescue station at Hazard and the first aid and mine rescue training there. A resolution was adopted supporting the position of the National Coal Association in opposing any liberalization of the diversion and reconsigning rules as applied to coal.

Robert S. Young, of Knoxville, secretary and treasurer of the Blue Diamond Coal Company, was the toastmaster at the banquet. The speakers included a humorist, Jess Pugh, of Indianapolis; Executive Secretary Gandy, of the National Coal Association; and State Senator Brock, of Harlan. W. E. Davis delivered the address of welcome and John P. Gorman the response. At the business meeting of the exchange, the retiring president, J. B. Hilton, of Chicago, vice president of the Columbus Mining Company, was presented with a fine golf bag and full complement of clubs in token of appreciation of his services, John P. Gorman making the presentation with brief but well-chosen remarks. Just prior to the presentation a representative was authorized to be appointed on a joint association committee looking toward broadening credit interchange activities of the Coal Bureau at Cincinnati.

Officers of the exchange were elected as follows: President, W. E. Davis, president, Midland Mining Company and Davis Collieries; vice president, John P. Gorman, president, John P. Gorman Coal Company; treasurer, H. E. Bullock, president, Kentucky Block Coal Company; and secretary, J. E. Johnson; all the officers being from Lexington. The new executive committee is composed of: A. L. Allais, Chicago, Ill.; James Bonnyman, P. H. Burlingham, Dan Pritchard, Cincinnati, Ohio; Geo. P. Fitz, Frank Medaris, Hazard, Ky.; J. H. Bowling, Hugh Buford, W. S. Dudley, H. K. English, John P. Gorman, T. W. Havely, E. C. Perkins, Carel Robinson, O. Reginald Ryley, Lexington, Ky.; W. F. Mandt, Carbon Glow, Ky.; and J. B. Allen, Allock, Ky.

The present officers of the Hazard Coal Bureau were reelected as follows: President, J. H. Bowling, and commissioner, J. E. Johnson. The following board of governors was also reelected: John Callahan, Calvin Holmes, James Bonnyman, and Irvin Davis, of Cincinnati; John P. Gorman, J. H. Bowling, and H. E. Bullock, of Lexington.

Operators of Williamson Field Adopt Code of Ethics

At a meeting of the operators of the Williamson field, held in Williamson, W. Va., the middle of January, with about 85 percent of the tonnage of that field represented, a code of ethics of business conduct was adopted, and the Williamson Coal Bureau was organized to further the workings of the code. J. J. Ardigo, who is secretary of the Operators' Association of the Williamson field, was named as commissioner of the new bureau. According to Commissioner Ardigo, "the code is fashioned after the Utah code, which was recently approved by the Federal Trade Commission."

New Edition of "Mac's Coal Directory"

The extent of the changed conditions in the coal industry during the past five years has been terrific and it would entail a tremendous amount of work for anyone to follow the course of events and keep track of the changes that have taken place. However, the Coal Information Bureau of Pittsburgh, Pa., publishers of "Mac's Coal Directory and Buyers Guide," with an active organization on a national basis and through active contact with the industry, have been able, to the limit of human efficiency, to keep track of the changes that have taken place in the coal industry and have compiled and printed for those interested this important data in their 1929-30 edition of "Mac's Directory," which is now off the press.

"Mac's Coal Directory" is compiled and published for those interested in the production, transportation, sale and consumption of coal and coke and is acknowledged to be the most up-to-date, accurate and complete compilation of essential coal data ever published. It contains a complete list of the coal-producing mines, arranged by states and counties therein, with a full description of each mine and also contains a list of selling companies, arranged by states and cities and shows by the use of cross-indexes, the relationship between those who produce and those who sell coal and coke. All this information is so arranged that with the least lead as to what information is required, complete details can be obtained.

"Mac's Coal Directory" has established itself as a very important and essential part of the coal industry, essential to the proper conduct of buying and selling and a publication that should be in the hands of everyone interested in coal.

It was established in 1920 and is issued annually—the 1929-30 edition being the ninth annual edition and by far the "best ever," in view of the many changes.

Copies can be obtained by writing to the Coal Information Bureau, Union Trust Building, Pittsburgh, Pa.; price, $10 per copy, postpaid.

The Coal Division of the Bureau of Foreign and Domestic Commerce has issued figures showing, by Customs Districts, the bunker coal supplied to vessels engaged in foreign trade for the years 1926, 1927, 1928 and 1929.

Figures on anthracite cargo coal loaded into vessels at Lake Erie ports, for the years 1921 to 1929 by months, have been published by the Bureau of Mines.

Consolidation's West Virginia Mines Make Safety Records in 1929

Establishing a new safety record for northern West Virginia, and possibly for the entire state, West Virginia Division mines of the Consolidated Coal Company produced an average of 1,358,254 tons per fatality during the year 1929.

Only three deaths due to accidents in the division mines, which comprise Marion and Harrison Counties, occurred in the 12 months, it is revealed by figures released from the office of F. F. Jorgenson, division manager.

Outstanding is the record established by Mine No. 32, Owings, which has mined 1,979,251 tons within the past several years without a single fatal accident.

Marion County plants have records almost equally noteworthy, officials said. Mine No. 63, Monoangah, has turned out 1,686,608 tons since the last fatality, and Mine No. 86, Carolina, has mined 1,554,095 tons without a major accident.

At Mine No. 57, O'Donnell, there has not been a fatal accident since the plant was reopened in 1919.

In four years Mine No. 29, Columbia, has had no fatal accidents, and has produced 1,221,410 tons with only one death.

Pinnickinnick Mine No. 25 has yielded 1,097,556 tons with but one fatality.

Mines operating throughout 1929 without the loss of a worker were New England No. 26, Monongah No. 63, Owings No. 32, Columbia No. 29, Highland No. 36, O'Donnell No. 37, and Pinnickinnick No. 25.

Sheridan-Wyoming Again Takes Lead in Safety Work for 1929 in Wyoming

The Sheridan-Wyoming Coal Company, Inc., and their subsidiary, the Hotchkiss Coal Company, have finished another year without a fatal accident in any of their three mines, according to Edward Bottomley, general superintendent. This makes the fifth consecutive year for the Sheridan-Wyoming Coal Company, and the Hotchkiss Coal Company, without the loss of a single life in or about the mines—producing during that time 4,434,780 tons.

Personnel of Glen Alden Coal Co.

As a result of the consolidation of the Glen Alden Coal Company, Scranton, Pa., and the Lehigh & Wilkes-Barre Coal Company, Wilkes-Barre, Pa., the following officers were designated by order of the board of directors, effective January 1, 1930:

C. F. Huber, chairman of the board; William W. Inglis, president; S. D. Dimmick, vice president and general manager; J. H. Oliver, vice president and general counsel; C. E. Ash, vice president and secretary; G. N. England, treasurer.

Major William W. Inglis, president of the new Glen Alden Coal Company, announced the following appointments, effective January 1, 1930:

Frank Hildebrand, Scranton, Pa., comptroller; E. R. Clark, Wilkes-Barre, Pa., general auditor; J. N. Shaw, Scranton, Pa., purchasing agent.

S. D. Dimmick, vice president and general manager, announced the appointment of Geo. V. O'Hara, as general superintendent of the Northern Division, embracing collieries in Lackawanna County and west of the Susquehanna River in Luzerne County, and Edward Griffith, as general superintendent of the Southern Division, embracing collieries east of the Susquehanna River in Luzerne County and those in the Lehigh region.

Lehigh Coal & Navigation Changes Approved

Stockholders of the Lehigh Coal and Navigation Company at a special meeting in Philadelphia, January 15, unanimously approved the management's program for revamping the corporate structure of the company. The vote was 460,225 shares for and none against. The plans approved follow:

Segregation of the company's coal lands and properties.

Conversion of the capital stock from $50 par value to no par value, an increase in the number of shares from 643,355 to 3,000,000 and the splitting up of the old stock on the basis of three new shares for each old share outstanding. Managers of the company also were given the authority to sell additional shares.

Division of the board of managers into three classes, each to serve for four years.

Acceptance of the provision of the state Constitution of 1874.

Samuel Warriner, president, made the following statement as to the purposes and effect of changing the company's structure:

"In order to prevent any question from arising under the Constitution of Pennsylvania of 1874, a segregation of the company's coal lands and mining properties is advisable. It is proposed, therefore, that the mining operations will be conducted as a unit, using for the purchasing company the existing charter of the Alliance Coal Mining Company, changing the name of that company to 'Navigation Coal Company,' or some similar name, and increasing its capital stock and changing or converting the same into stock without nominal or par value.

"The consideration for the sale of the coal properties will be the issuance to this company of the entire capital stock of the purchasing company.

"The proposed change or conversion of the capital stock into stock without nominal or par value is in accordance with modern practice. The conversion will be effected at as early a date as possible after March 1, by issuing three shares of the new stock, without par value, in exchange for each outstanding share having a par value of $50."

W. H. Cunningham Resigns as Secretary of the West Virginia Coal Association

At a meeting of the executive committee of the West Virginia Coal Association in Charleston, January 16, W. H. Cunningham resigned as secretary, effective February 1. Mr. Cunningham is president of the Truax-Traer Coal Company, with general offices in Chicago and with coal-producing properties in West Virginia, Illinois and North Dakota. He stated that he found his time so absorbed with the affairs of his company that he felt constrained to retire from the West Virginia secretaryship. Mr. Cunningham has been secretary of the West Virginia Coal Association for many years and has rendered valiant service there for the bituminous industry of that state. J. G. Bradley, of Dundon, W. Va., president of the Elk River Coal & Lumber Company, and president of the West Virginia Coal Association, announced that a meeting of the association for reorganization purposes would be held at Charleston on February 6.

Illinois Society of Engineers Meets

The Illinois Society of Engineers held its annual meeting at the Broadview Hotel, East St. Louis, Ill., on January 22, 23 and 24. The sessions on the 23d were devoted to a very interesting program on the subject of "Modern Methods in Open-Cut Coal Mining," with the following program:

"Prospecting and Exploration of Coal Stripping Areas," by Dr. M. M. Leighton, chief, State Geological Survey, Urbana; G. H. Cady, senior geologist, State Geological Survey.

"General Layout of the Duquoin Strip Mine," by James C. Anderson, United Electric Company, Danville, Ill.

"Mechanical Appliances Used in Strip Mining," by D. J. Shelton, Marion Steam Shovel Co., Marion, Ohio.

"Modern Explosives in Strip Mining," by Don B. McCloud, Liquid Oxygen Manufacturer, Duquoin, Ill.

"The Reclamation of Strip Mine Land," by E. G. Searls, Crerar-Clinch Co., Chicago.

Utah Coal Trade Conference Adopts Code

Rules of business practice adopted in the first trade practice conference of the bituminous coal industry have been acted on by the Federal Trade Commission. The conference was held December 3 in Salt Lake City for operators in the State of Utah, but coal producers in other parts of the country were interested and representatives of the Southern Appalachian Coal Exchange, covering the States of Tennessee, Kentucky, Alabama and Virginia attended and participated in the conference. Commissioner William E. Humphrey, of the commission, presided at the meeting, assisted by George McCorkle, assistant director of trade practice conferences.

Besides adopting rules of business practice the industry formulated a set of definitions upon which the commission has taken no action. These definitions, full texts of which are given in the commission's statement, cover the following subjects: The term "The Industry"; a producer; a retail dealer; and such preparations of coal as "Dust," "Screened Slack," "Stack," "Nut," "Domestic Lump," "Stove or Cobble or California Lump," "Lump," and "Mine Run."

Rules affirmatively approved as condemning violations of the law, apply to such practices as misrepresentation of analyses or sizes of coal, unlawful use of a competitor's trade-mark, disparagement of competitor, inducing breach of contract, secret giving of rewards, and selling coal below cost to injure competitors.

Rules accepted as expressions of the trade pertain to such subjects as cancellation of contracts, payment of freight charges by a seller of coal, giving discounts with the effect of altering retroactively the price quoted, discrimination in price through post-dating or predating an invoice or contract, according a purchaser the equivalent of a discount on coal purchases through the furnishing of equipment or yard facilities, publication of price lists, quoting false prices, discriminations through consigning coal otherwise than on bona fide order, and arbitration.

Pittston Company Formed To Operate Erie Coal Properties

Erie Railroad Company has segregated its anthracite properties in Luzerne and Lackawanna Counties, Pennsylvania, formerly operated by Pennsylvania Coal Company and Hillside Coal & Iron Company, through the organization of the Pittston Company, which acquires not only the coal properties but also controlling interests in other concerns engaged in the distribution of coal.

In order to finance its stock acquisition, the Pittston Company will shortly offer for sale to Erie stockholders 1,075,100 shares of an authorized issue of 2,500,000 shares of common stock. Erie stockholders of record January 28 will be given the right to purchase Pittston stock at $20 a share in the ratio of one share of Pittston for each two shares of Erie of any class.

The new company has also purchased control of United States Distributing Corporation, and has acquired several other coal distributing companies in New York territory. These increased facilities are expected to enable the Pennsylvania and Hillside coal subsidiaries of the Erie to increase their annual production by about 2,500,000 tons.

United States Distributing controls the United States Trucking Corporation, one of the largest trucking enterprises in the country.

Michael Gallagher, chairman of the board of the Pennsylvania Coal Company, has been named president of the Pittston Company. Other officers are: vice president in charge of operations, John C. Brydon; vice president in charge of sales, Gardner Patterson; comptroller, Charles R. Nash, and treasurer and secretary, R. W. Radcliffe.

Charles E. Denny, president of the Erie, states that the directors in approving the organization of the Pittston Company had in mind two important considerations:

"That the operation of the coal properties by the Pittston Company and the distribution of that company's stock will completely separate the Erie Railroad Company from any interest in the coal mined from the properties of the Pennsylvania Coal Company and Hillside Coal & Iron Company and transported by the Erie Company, and

"That the operation under lease by the Pittston Company of the coal properties of the Pennsylvania Coal Company and Hillside Coal & Iron Company, and the acquisition by the Pittston Company of facilities for the distribution of coal, promise a more profitable operation of the coal properties."

Enzian Appointed Chief Engineer of Consolidated Coal

Charles Enzian has been appointed chief engineer of the Consolidation Coal Company, with offices in Fairmont, W. Va. Mr. Enzian comes to the Consolidation from the Berwind-White Coal Mining Company of Windber, Pa., with which organization he had been associated for the past seven years as chief mining engineer. Mr. Enzian is a graduate of Lehigh University and his association with the coal industry covers a period of 35 years in an engineering and operating capacity, he having been affiliated at various times during this period with the Lehigh Coal and Navigation Company, Lehigh Valley Coal Company, U. S. Bureau of Mines, Philadelphia and Reading Coal and Iron and others, as well as having engaged for some time in consulting work in the bituminous and anthracite region of Pennsylvania, Canada and the Middle West.

Bardo Coal Mining Company Adopts Group Insurance

Announcement has been made of the adoption of a group life insurance policy by the Bardo Coal Mining Company, of Bardo, Ky., for the protection of that company's 160 workers. The policy was placed with the Prudential Insurance Company of America, the total amount involved being $82,000.

Each worker receives protection varying in amounts ranging from $500 to $1,500, according to the rank or position held, and the policy is of the contributory type, the workers paying a part of the premiums and the employing company assuming the remainder of the expense.

Midvalley Anthracite Breaker Resumes Operations

The new Midvalley Breaker of the Hazle Brook Coal Company, subsidiary of the Jeddo-Highland Coal Company, of Jeddo, Pa., commenced working on January 13.

The breaker is modern in every way and has a capacity of 1,000 tons per day—normal production. The plant is electrified entirely and uses the Chance cleaning method for the preparation of the coal. Several other novel features have been worked into the design, making the plant the last word in efficient coal preparation. Two hundred men will constitute the operating force of the breaker.

The breaker is on the site of the former Midvalley Breaker and will prepare the remaining coal from the No. 2 Midvalley Basin and from the new No. 3 Midvalley Basin which has recently been leased and which contains several million tons of virgin coal.

S. B. Johnson Elected President of Lorado Coal Mining Company

Stanley B. Johnson has been elected president in charge of operations of the Lorado Coal Mining Company, with operations in Logan County, W. Va., succeeding Judge R. L. Wildermuth, resigned. Mr. Johnson is a son of Edward Johnson, the founder of the company and chairman of the board. James W. Johnson has been named general manager, and George W. Wyss, assistant general manager. Judge Wildermuth has also resigned as general manager of the Lorain Coal & Dock Company, with operations

in Ohio, and he has been succeeded by Stanley B. Johnson as vice president in charge of operations. James W. Johnson and George W. Wyss have also been elected general manager and assistant general manager, respectively, of the Lorain Coal & Dock Company.

C. F. & I. Resumes Dividend

The board of directors of the Colorado Fuel and Iron Company, on January 28, voted the declaration of a regular 2 percent quarterly dividend on the company's preferred stock, and a 50-cent dividend on common stock, of which there are 342,000 shares outstanding. The dividends are payable February 25 to stockholders of February 10 record. This is the first dividend to be declared on the C. F. and I.'s common stock since 1921.

Coal Carbonization Assays

Low-temperature carbonization assays are being made of samples of coal from every mine in the state of Washington as a part of an investigation being conducted by the Northwest Experiment Station of the Bureau of Mines, Seattle, Wash., in cooperation with the University of Washington. Coals of all ranks from anthracite to lignite occur within the state. The object of the work is to provide basic information concerning the behavior of the coal when carbonized at comparatively low temperature in advance of any industrial development in this method of utilization.

C. & O. R. R. Opens Coal Service Bureau at Detroit

The Chesapeake & Ohio Railway Company on January 1 opened a coal department in the Dime Bank Building, Detroit, Mich., in charge of J. H. Phillips, who for the past several years has traveled in that section as a coal traffic agent. It is understood that the object of this special agent is for the purpose of enabling him to devote his entire time to the promotion of coal traffic on the C. & O. and affiliated lines and to give the users of coal better service.

Centrifugal Concentration

An investigation of the centrifugal concentration of certain types of ores, especially the application of the process to the treatment of the slime portion of tailings from mills that use gravity-concentration methods, has been conducted at the Rare and Precious Metals Experiment Station of the Bureau of Mines, Reno, Nev., in cooperation with the University of Nevada. A centrifugal bowl designed by H. A. Doerner, of the Bureau, gave encouraging results in preliminary tests on slime tailings from a mill concentrating a scheelite ore.

Technical Paper 457, "Centrifugal Concentration: Its Theory, Mechanical Development, and Experimental Results," has been published by the Bureau, covering the results of this investigation.

G. G. Crawford New President of Jones & Laughlin

George G. Crawford, formerly president of the Tennessee Coal, Iron & Railroad Company at Birmingham, Ala., has resigned to accept the presidency of the Jones & Laughlin Steel Corporation at Pittsburgh. Herbert C. Ryding, vice president in charge of operations, has been named to succeed Mr. Crawford.

Tidewater Coal Shipments

The total quantity of soft coal handled by the five principal tidewater ports—New York, Philadelphia, Baltimore, Hampton Roads and Charleston—amounted to 38,050,908 net tons in 1929, according to the Bureau of Mines. This exceeds the figure for 1928 by 3,332,526 tons, or 9.6 percent, and is slightly higher—212,296 tons—than that for 1927. Shipments via tide to New England were approximately 1,000,000 tons greater than in 1928. Shipments destined for export increased 399,409 tons, or 16.3 percent.

Westinghouse Salute to the Coal Industry

Address of Thomas Stockham Baker, President of the Carnegie Institute of Technology, over the Chain of The National Broadcasting Company Wednesday, January 22, 1930

The International Conferences on Bituminous Coal, which were held at the Pittsburgh in 1926 and 1928, have made it clear that coal can no longer be regarded merely as fuel—as something that exists only to be burned. We are learning more and more about the composition of this substance, and we discover that it contains many components which are of small value in the process of combustion, but which are useful in other ways. So we must now speak of coal as a raw product which can be turned into a variety of commodities, just as can iron ore or copper. Some day we shall feel that it is uneconomical, wasteful, bad business, not to treat coal before it is used for fuel.

In Germany it is estimated that during 1929 nearly 50 percent of all the coal was employed, underwent some sort of process before it was burned. Today coal is cheap, but the man in the street does not realize that however remote the day of absolute exhaustion may be, we have an immediate problem in the increasing natural difficulties of mining. The richer coal deposits are being used up. Those that are most accessible are being exploited, and as the workings grow deeper the obstacles to be overcome are more serious. Therefore we can be assured that in the not distant future the cost of producing coal will mount and the necessity for getting more out of this commodity will be more certain. Consequently, no opportunity should be overlooked of increasing its value without, if possible, raising the cost to the consumer of fuel.

One of the chief objectives of coal research is the securing of a smokeless fuel. It has been shown that in one of our great American cities 1,800 tons of soot-fall is deposited over 1 square mile in a year. The smoke itself is an indication of imperfect combustion, and is therefore a form of waste. In every thickly settled community it costs millions because of its destructive effects upon buildings and their contents. Its influence upon the health of a community must also be considered. Therefore the securing of a fuel that will obviate these conditions is of extreme importance.

In the future, less fuel will be transported and a wide variety of chemical and other industrial establishments will be located near the mines, where there will be at hand the tar of the by-product coke ovens and the low temperature retorts to be utilized. Not only shall we have more of the ammonium sulphate of the present coke ovens to dispose of, but the hydrogen gained by the coking of coal will be combined with atmospheric nitrogen to produce other forms of fertilizer. When the time comes to supplement the nation's store of mineral petroleum, coal will be liquefied to keep the Diesel and other internal combustion engines going. There are other forms of manufacturing which will be forced to the coal fields, where there are cheap power, cheap gas, cheap coke.

The application of science to the study of a raw material which contains so much potential wealth can not fail to contribute to the industrial, economic, and social progress of our country.

The United States possesses one-half of all the known coal deposits of the world. If we attempt to forecast the course that civilization is likely to follow, we shall be compelled to keep before us the significance of this magnificent and precious national asset. The country that has the richest resources in power, becomes a leader among nations because of its great store of energy. Our wealth of coal assures to our country a long continuance of its industrial greatness. It is the most cogent reason for believing that the citizens of the United States will for many generations live under conditions of material prosperity.

WITH THE MANUFACTURERS

New Explosives Developed for Mining Industry

The continued studying of the performance of explosives in field and laboratory and the strict chemical control of their manufacture has promoted the efficiency of all types and introduced several new explosives during the past year, according to officials of the Hercules Powder Company.

During the past year the Hercules Company has announced three new explosives. Two of these have been of the Hercoal type, which are very high count permissible explosives. Hercoal F, developed two years ago as a permissible which would shoot coal with the economy and lump producing qualities of black powder, has proved that it filled a vital need in the coal industry.

It was found, however, that Hercoal F needed to be supplemented with similar powder which will shoot coal under varying mining conditions. Hercoal F has a cartridge count of approximately 500 1¼ by 8 in. cartridges per 100 pounds.

Hercoal C, the next permissible of this group introduced by Hercules, has a cartridge count of approximately 400 1¼ by 8 in. cartridges per 100 pounds. It has similar characteristics to Hercoal F but is stronger. During the year a permissible midway in count between these two was introduced. This permissible, Hercoal D, has a cartridge count of approximately 450 1¼ by 8 in. cartridges per 100 pounds.

In other fields, also, great economies have been effected for users of explosives during the past year. The Hercomite series, high ammonia content explosives known for relative safety and economy, have been widely adopted for mine and open pit operations.

Another development made to fulfill the requirements of Hercules engineers was the production during the past year of the new Hercules 10-cap blasting machines. After a long period of experimentation, a pocket size blasting machine of the dynamo type was perfected.

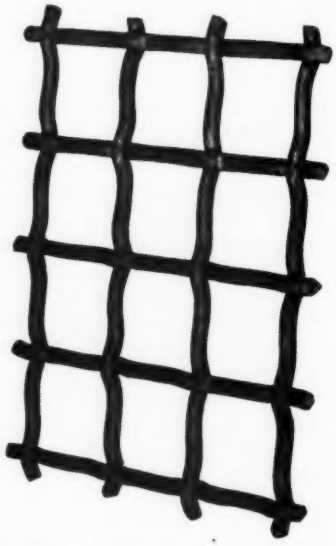
Owing to the advances made in the explosives manufacturing during the past few years, freezing is no longer a problem, there being few modern dynamites which will not withstand temperatures ordinarily encountered.

While new explosives developments are constantly being made, much research and experimental effort goes into the development of still greater efficiency and uniformity in standard dynamites, gelatins, and permissibles which are widely used in coal, metal, and nonmetallic mining.

Ludlow Saylor Has New Woven Wire Screen

The Ludlow-Saylor Wire Co. of St. Louis have just released a four-page leaflet describing "Arch-Crimp" woven wire screens for coarse sizing.

Arch-Crimp is an entirely new development in the weaving of wire screens of large openings. It is especially designed for severe service on vibrating screens. It is also ideal for revolving screens and forms rigid cylinders or cones which keep their shape and accuracy until the steel is worn away.



The new "Arch-Crimp" Screen

This screen is a great advance over the old-style intermediate-crimp screen. Tension can not stretch it; the wires resist extreme abrasion; the weave is tight and very rigid; there can be no "creep" between the wires, no bulging or sagging under load.

For copies of the leaflet apply to The Ludlow Saylor Wire Co., St. Louis, Mo.

Byers Company to Produce Wrought Iron By New Process

A finding that is bound to have the most profound effect upon the entire iron and steel industries is contained in the issue of the United States Bureau of Standards Journal of Research just published.

Briefly, it is that the Government bureau gives official recognition to the product of a new process for making wrought iron,

The story revolves around some development work that has been going on, unknown to all except a comparatively few of the world's leading metallurgists, in an abandoned iron mill near Pittsburgh.

The files of the bureau of industrial statistics show that as late as 1870 only about 30,000 long tons of Bessemer steel rails were produced as against more than 500,000 tons of iron rails. Open-hearth steel production of all kinds was only about 1,300 tons while the value of the wrought iron output mounted into many millions of dollars.

And then steel became king when the invention of the Bessemer converter made possible the virtually automatic production of tremendous tonnages of low-cost steel.

Scores of metallurgists throughout the world tried to reproduce the magic wrought in the puddler's furnace by nature, fire and the strength of the artisan's arms, but failed, and it remained for an educator—Dr. James Aston, director of the department of mines and metallurgy of Carnegie Institute of Technology — to solve the puzzle that thwarted the entire industry. Tackling the problem from an entirely new angle, and using for his practical laboratory an old mill at Warren, Ohio, leased for the purpose by the A. M. Byers Company, of Pittsburgh, the old established wrought iron pipe manufacturers, Dr. Aston produced pure wrought iron in unbelievable quantities and without the aid of the iron puddler.

A new $10,000,000 plant for mass production of pure wrought iron by the

"New Byers Process" soon will be opened north of Ambridge, Pa., on the Ohio River, a few miles from Pittsburgh.

Leading metallurgists regard the prospective opening of this tremendous new plant as of the most far-reaching significance. Marking the turning point of an industry that dates back to antiquity but that always has been dependent upon skilled hand labor, it means that modern production methods at last have been brought to wrought iron, which only 60 years ago far exceeded steel. Also, they say, it means ultimately a general realignment of the metals trade.

Solving Power Factor Problems With Scale

The General Electric Company announces a new system of solving power factor problems. This is a graphic method involving simple computations only, and is described fully in a new publication, GET-191, entitled "Solving Power Factor Problems by Scale."

Heretofore the calculations relating to power factor and its improvement have been difficult for those most vitally interested, and at best did not visualize the conditions that might result from different treatments. In brief, the new system consists of laying down to scale the known factors and then scaling the unknowns. Many problems are illustrated in the booklet, as well as several solutions for one problem, so that there should be no difficulty in applying the simple rules. Thus the effects and probable costs of improving power factor by unity-power-factor synchronous motors, by capacitors or by synchronous condensers may be scanned and compared. Increased load-carrying capacity is readily measured and rearrangements suggest themselves.

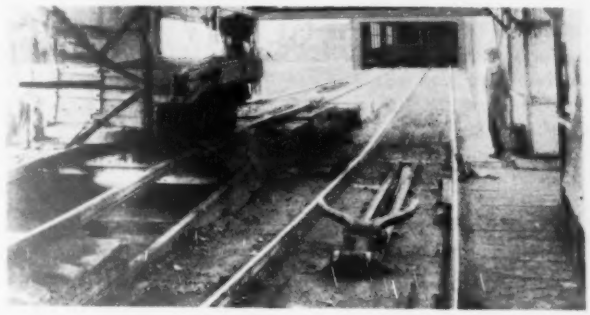
All that is needed for computation is a scale, a pencil and paper. A right-angle triangle with the sides in proportion 3 to 4 to 5 is furnished with the booklet and this, together with a small T-square, save time in the calculations and make the work more accurate.

In the actual calculations, horsepower at unity-power-factor is expressed in terms of inches measured horizontally. Lagging power factor is represented by lines slanting upward to the right, and leading power factor, by lines slanting downward to the right. Where it is desired to improve lagging power factor, and to determine the amount of leading power factor necessary to accomplish this result, a triangle is laid out using the horizontal unity power-factor line and the upward lagging power factor line. Then by applying the 3-4-5 triangle the necessary corrective value may be established. Other problems are solved in a similar manner.

Electric Reciprocating Car Feeders

An electric reciprocating car feeder, capable of eliminating difficulties usually encountered, and designed for efficiency in feeding mine cars, is being offered by Roberts and Schaefer Company, of Chicago.

The feeder has but one carriage in which there is a forked dog or duck hook, designed especially for the car, which engages the axles near the bearing wherever there is the least tendency to bend the axles; or it engages the bearings themselves, or engages the ends of cars, depending on the type of car used. This dog is held up by a positive spring action, insuring its engagement of the cars at all times, though it permits the passage of the locomotive over it. The carriage has a long wheel base to distribute the eccentric pull, and extra guide wheels to prevent the bending of the guides. The load is picked up against a powerful spring cushion.



The whole unit is of rugged construction. The carriage runs forward and back on heavy I-beam guides mounted on cast steel supports. There are no guides required for the return strand or lower strand of chain. The chain used is a short pitch, permitting the use of small sprocket wheels which require less excavation and a simpler supporting structure than required by other types of car feeders. The drive unit consists of a motor, speed reducer and brake.

Majored among the advantages of this electric reciprocating feeder are: No lugs required on the cars, no bending of axles, absolute control of trip at all times, adjustable length of stroke for varying weather conditions and friction of cars, fewer moving parts—less upkeep, lower installation cost, design permits heavier construction.

The operation is simple; by pushing a control button the carriage travels forward whatever distance the stroke is set for, automatically reverses and returns to its starting position and stops. It is not necessary to push any button to change its direction or stop the carriage, as this is automatically done through the electrical control. Emergency buttons, however, are provided so that the carriage may be reversed at any point of the forward stroke or stopped, as desired. The ability to vary the length of stroke is a big asset. In fair weather conditions when the cars are moving rather freely it may be necessary to take but a partial stroke and permit the cars to drift the remainder of the distance by themselves. In bad weather, or as the cars become cold and do not move as freely, it may be found necessary to take a considerably longer stroke to deliver the cars to the point desired. A simple adjustment of the switches permits making this change. Operating the car feeder by remote control from any position is possible as required. In the accompanying illustration the dump operator controls the operation of the car feeder. In this way the cars are delivered to the car-dumper as they are required; otherwise the time for dumping would be entirely determined by the method of feeding the cars to the car-dumper.

These feeders also make excellent trip-makers, saving grading of track for empty holes and eliminating bumping together of cars after running a long distance down an empty siding. Construction of a knuckle over which the cars are fed is also eliminated in order to get sufficient grade so that the empties will run away.

For service as a trip-maker the feeder is started by a switch operated by the car itself as it comes off the kickback and the whole train is advanced one car length on the arrival of each car from the kickback. The car feeder, therefore, is not operating except when it is necessary to feed the empty trip forward to make room for the oncoming empties. This makes for an appreciable saving in power cost.

Ohio Brass Opens Office in Seattle

In order to better serve its customers in the Northwest, the Ohio Brass Company, with general offices at Mansfield, Ohio, has opened a branch office in Seattle, Wash. The new office, with J. W. Watkins in charge, is located in room 1018 of the Northern Life Tower at 1218 Third Avenue.

Roberts and Schaefer Contracts

The following contracts have been closed recently by Roberts and Schaefer Company, of Chicago:

Stonega Coal and Coke Company, Sun, W. Va., have contracted for coal washing equipment, embodying the use of the Menzies hydro separator for washing nut coal; capacity 50 tons per hour. Erection to be completed February 1.

Allegheny River Mining Company, Kittanning, Pa., have contracted for complete tipple equipment for four-track tipple, embodying rotary dump and car feeding equipment, retarding conveyor, Marcus picking table, screen loading rooms and car retarder. Capacity 30 tons per hour. Erection to be completed April 1.

Mead Smokeless Coal Company, Vanwood, W. Va., have contracted for screening and coal washing equipment, embodying the use of Menzies hydro separator for cleaning nut and pea coal. Capacity 50 tons per hour. Erection to be completed March 1.

The Manor Coal Company, Vendix, Md., have contracted for the complete installation of a three track tipple, embodying the use of Marcus picking table, screen loading booms and for washing nut coal there will be embodied, the Menzies hydro separator. Capacity of tipple 250 tons per hour. Erection to be completed April 1, 1930.

New Air-Cooled Single-Stage Compressor

A new model air-cooled single-stage compressor has been placed on the market by the Gardner-Denver Co., of Quincy, Ill. This is to be known as the A-C-E Model. It consists of a 3½ by 4 duplex compressor and a 5-hp. motor mounted on a cast iron base on top of the air receivers. The unit has a displacement of 26 cu. ft. per minute, operating at a rate of 600 revolutions per minute. This rate can be reduced and altered to fit the particular circumstances. Specifications follow:

An outstanding feature is the enclosing of the suction and discharge valves in separate compartments. The valves are special, heat treated and ground steel discs. The use of the compartments prevents the air from being heated when passing through the intake valves.

An automatic or hand-operated start and stop control is furnished as standard equipment and operated in conjunction with the Penn type pressure and moisture unloader. The unloader is set to cut in at 130 pounds and out at 165 pounds. Continuous operation is assured by this control.

Lubrication for the compressor is by the controlled splash type. A positive driven plunger pump on the outside of the crank-case feeds filtered oil to the troughs under the connecting rods. A special oil ring and groove on the piston prevents oil from passing over to the discharge lines. An oil level gives positive indication of the amount of oil in the reservoir.

Other features of this compressor are: The use of the V-type belt drive; a fan type of flywheel; use of Hyatt type of roller bearings; aftercooler in the base and a muffler for the suction opening.

Large Direct Traction Mine Hoist Installed

An order has been placed with Westinghouse Electric and Manufacturing Company by the Consolidated Steel Corporation of Los Angeles, Calif., for direct traction hoist equipment to be installed at the Man Shaft-Estrella Underground of Nevada Consolidated Copper Company, Chino, N. Mex. The design of this hoist will be similar to the modern direct traction type elevator employed in office buildings but the size is considerably greater than any thing yet developed in this line.

The hoist will operate a single cage and counterweight in the vertical shaft 660 ft. deep at a maximum hoisting speed of 700 ft. per minute. Although it is intended primarily as a man and supply hoist, the equipment will be of sufficient capacity to hoist ore continuously.

In the traction type of hoist a multiplicity of small diameter ropes is used, each rope attached at one end to the cage and at the other end to the counterweight and the ropes are carried through grooves in the traction sheave and idler sheave, making a triple wrap, the entire driving force on the hoisting rope being obtained by traction on the driven sheave. The traction sheave is mounted on an extension of the hoist motor shaft which also carries the wheel of a spring-set solenoid brake, the whole assembly being carried in two pedestal bearings on a common bedplate to be mounted in the head-house above the mine shaft.

The hoist motor is a direct current machine rated 275 hp., continuous at 6,500 ft. altitude, 250 volts, 64 r. p. m. Power will be supplied by a 250 kw. synchronous M-G set driven from the 2,200 volt, 3 phase, 60 cycle a. c. supply. The motor will be controlled on the variable voltage system with refinements of control similar to those applied in high speed elevator practice for graduated automatic acceleration and retardation and accuracy in stopping. Control will be obtained normally from a car switch carried on the stage with provision for transferring to a similar switch at the surface in case the cage is so loaded as to leave no room for an operator. Provision is also to be made for operation from push buttons on the cage if desired.

Sullivan Branch Office at Johannesburg, S. A.

Sullivan Machinery Company announces the establishment of a branch office at Johannesburg, South Africa, as Sullivan Machinery Company, Africa (Proprietary), Ltd., Geneva House, Johannesburg, Transvaal.

Charles C. Smith, formerly of the Sullivan staff, but more recently manager for Barlow's Johannesburg (Proprietary), Ltd., Sullivan agents in South Africa, will be manager of the new office.

Messrs. Barlow's Johannesburg (Proprietary), Ltd., and Thos. Barlow & Sons (S. A.), Ltd., Durban, Natal., continue as Sullivan agents in their respective territories.

A branch office, warehouse, and service station for Sullivan equipment, and particularly for Sullivan Diamond Core Drills, has been established at N'Dola, in Northern Rhodesia.

Worthington Forms California Subsidiary

On and after January 2, 1930, the interests of Worthington Pump and Machinery Corporation in the California territory are being served through a local company, the Worthington Machinery Corporation of California, Ltd., with headquarters at Los Angeles and San Francisco.

H. D. Cornell, who has been president of the Worthington Machinery Corporation of Oklahoma, will be president of and direct the new corporation, moving to California for that purpose. George W. Hawkins, who has been the director of sales, will also go with Worthington-California as vice president.

The Worthington Machinery Corporation of California, Ltd., will take over the sales and engineering staff and the warehouse facilities of The Worthington Company, Inc., in California, and will hereafter handle all that territory. This arrangement will enable the carrying of larger and more diversified stock of Worthington products and parts, and give more prompt service.

Worthington Pump Official Dies

Clarence W. Hodges, general purchasing agent of the Worthington Pump and Machinery Corporation, was taken suddenly ill and died January 17 at the Paterson, N. J., Hospital as a result of an operation. He was 53 years old.

Mr. Hodges was born at Randolph, Vt., May 15, 1876, and was graduated from Williams College with the class of 1900. For some years he was employed by the American Locomotive Company as purchasing agent, and since 1918 he had been employed in the same capacity by this corporation.

Cooperation of Manufacturers Will Speed Up Census Data

At a meeting of trade journal representatives in Washington, D. C., on January 29, Edward R. Dewey, in charge, Business Organization Service, Bureau of the Census, Department of Commerce, made an appeal for cooperation on the part of manufacturers in the present census survey being made of industry generally. Mr. Dewey pointed out that to be of greatest practical value census of manufacturers reports must be timely. In the past they have been terribly slow. For example, preliminary reports of the 1927 census of manufacturers for some industries took 74 weeks to get out. The average time was 55 weeks.

As a result of this, the Census Bureau has been the target for much unfavorable criticism, although it takes the bureau less than *three weeks* to publish the preliminary report for an industry after *all* the manufacturers in the industry have filed acceptable reports. Practically the entire delay in getting out census reports is due to the manufacturers themselves.

The Bureau of the Census asks for promptness and accuracy on the part of manufacturers in filling out the questionnaire form 1127.

Gould Pumps, Inc., Issues Centrifugal Pump Selection Charts

Goulds Pumps, Inc., Seneca Falls, N. Y., are distributing a new pump bulletin entitled "Goulds Centrifugal Pump Selection Charts." This bulletin is, from the user's standpoint, one of the most helpful pieces of printed matter ever issued by any centrifugal pump manufacturer.

Charts show the efficient range of 26 different double suction pumps at five different speeds. From these charts one can determine the pump to use for any given capacity and head, and also the size of motor required to drive it. Instructions for using these charts are given.

The Great Northern Railway Electrification

The Great Northern Railway Electrification is the title of a special publication, No. 1857, recently released by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The foreword in this 24 page booklet is written by Ralph Budd, president of the Great Northern. The history of the electrification is given, followed by a thorough description of the present distribution system, the locomotives, operation of the system and maintenance of the locomotives and equipment. The booklet is profusely illustrated with diagrams, drawings and photographs.

Atlas Powder Appoints Representatives

The Atlas Car & Mfg. Company, Cleveland, Ohio, announce the appointment of Goggin & Mills, 5 S. Wabash Avenue, as Chicago representatives for the sale of its products consisting of industrial equipment, industrial storage battery and trolley locomotives, storage battery trucks and tractors, and industrial cars, track, and turntables.

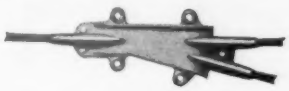
Bethlehem Employes Own More Than $22,000,000 of Stock

E. G. Grace, president of Bethlehem Steel Corporation, announced that since the corporation first offered preferred stock to its employes six years ago they have paid under the saving and stock ownership plan more than $22,000,000 and have received in dividends and special benefits approximately $4,000,000. During the last six years about 35,000 employes, practically half the total number, have become stockholders. Mr. Grace also announced a new offering to employees of Bethlehem 7 percent cumulative preferred stock at $125 per share.

New Mine Trolley Frog For Heavy Wires Is Easily Applied

Recently there has been a very decided increase in the use of 6-0 trolley wire by many mine operators throughout the country. Simultaneously has come the demand for a trolley frog which will eliminate the necessity of bending the wire when the frog and cam tips are installed.

In answer to such a demand, the Ohio Brass Company, Mansfield, Ohio, has



developed a new Type PC Mine Trolley Frog. This device is so shaped that the large wires lie in grooves without bending or preforming. Tightening the clamping pieces is all that is necessary to put the slight curve required in the wire.

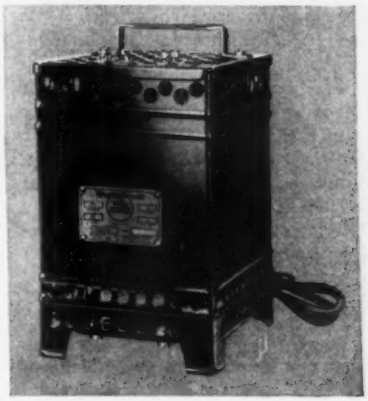
In addition, the tips are so formed that the current collector rides in and out of the frog smoothly without the necessity for peening the lips around the wire. This not only simplifies the work of installation but also makes it impossible for careless or negligent application to impare the correct operation of the frog.

The new PC frog is furnished either with a bronze body or one of O-B Flecto Malleable Iron, hot-dip galvanized. In both models, the clamping pieces are of galvanized iron. It is supplied in either right or left hand, 15 degree turn out.

New Westinghouse Battery Charger

A new Rectox rectifier for charging batteries by means of copper oxide rectification is announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Employing the copper oxide principle this charger presents a simple, safe, and satisfactory means for charging storage batteries in all applications.

The Rectox is easy to operate. It is necessary only to plug into any available lamp socket, attach the d-c. leads to the battery terminals and turn on the switch



mounted on top of the charger. A few hours charging will put renewed life into the battery with no attention whatsoever.

Being light in weight, the Rectox can be moved to the battery easily. The trouble usually encountered in moving heavy batteries is eliminated. In automobiles the charger may be placed on the running board, making the connections with the battery left in place in the car.

The leading feature of the Rectox charger is the fact that there are no parts to wear out or replace, with the exception of fuses which protect both the a-c. and d-c. circuits. No chemicals or acids are used, and there is no danger of explosion or corroding fumes.

The rectifying unit consists of a long life, dry-type rectifier, made from copper. No bulb can burn out or become inoperative as in the bulb type charger. The copper oxide principle of rectification takes advantage of the electrical properties of copper, coated with a layer of copper oxide. The unit formed in this way allows electric current to pass in one direction only. Since there is no electrolytic or chemical action, the Rectox does not wear out.

The Westinghouse Rectox charger can be used in the home, in public garages, industrial plants, central stations and anywhere a storage battery needs charging. Radio set batteries and automobile batteries can be serviced by the Rectox.

H. W. Caldwell & Son Co. Announces New Standardized Elevator Drive

A new standardized drive for elevators has been announced by H. W. Caldwell & Son Company of Chicago. This drive is compact, efficient and positively quiet at all speeds. It is built to operate centrifugal discharge, perfect discharge or continuous bucket elevators requiring 3 to 15 hp. The entire line is standardized and carried in stock.

The first reduction of the drive is made up of a ruggedly built fully enclosed worm gear speed reducer to which a motor is coupled. The second reduction in speed is made by a Link-Belt roller chain drive, which was selected because it furnishes a maximum of strength, durability, efficiency and quietness of operation, combined with a minimum of weight and of space required. It also acts as a flexible connection between the reducer shaft and head shaft.

A new book, No. 1086, just published, is devoted to the construction of the unit and illustrates installations. This book will be sent upon request.

Geared Turbines for New Oil Tankers

Four new oil tankers for which contracts have recently been placed are to be propelled by De Laval geared steam turbines. Two are to be built by the Federal Shipbuilding & Dry Dock Company for the Standard Shipping Company of New York, and two by the Bethlehem Shipbuilding Corporation for the Sinclair Navigation Company. The two Standard Oil tankers, which are rated at 18,000 tons each, will measure 444 ft. length, 74 ft. beam and 40 ft. 6 in. depth, and will draw 28 ft. They are to be driven at 11 knots by De Laval compound steam turbines with double reduction gears, rated at 4,000 shaft hp. and capable of developing a maximum of 4,400 hp. The two Sinclair tankers will measure 331 ft. length, 57 ft. beam, 32 ft. depth and 24 ft. draft, and will be rated at 8,400 tons. They also are to be equipped with compound turbines with double reduction gears built by the De Laval Steam Turbine Company, Trenton, N. J. Steam will be supplied at 350 lbs. per sq. in. gage from Babcock & Wilcox boilers. The designed speed is 13 kuots. The propelling units to be installed in these tankers are of the same general type as those which have rendered such satisfactory service in the *Dixie*, *El Oceana* and *El Coston*. Marine steam turbines of this size and type, using high pressure, high temperature steam, regenerative feed water heating, air heaters and economizers to improve boiler efficiency, are capable of developing a shaft horsepower on an oil consumption of ground .6 lb. to .7 lb. per hour, including steam used for all purposes on shipboard.

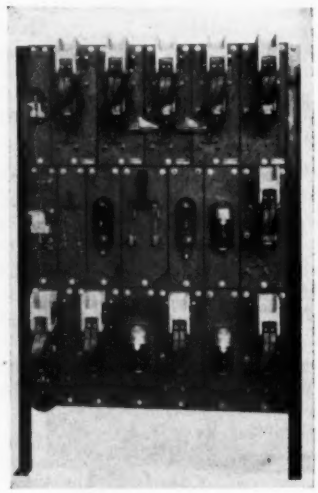
Booklet on Arc Welding of Cast Iron

A recent publication of the Westinghouse Electric and Manufacturing Company is "Arc Welding Data No. 11 on the Arc Welding of Cast Iron." This bulletin points out some of the properties of cast iron and gives a recommended procedure to be followed in arc welding.

New Dynamic Braking Controller for Crane Hoists

A new dynamic braking controller for crane hoists is being built by The Electric Controller & Mfg. Company of Cleveland, Ohio. This controller, known as "The Wright Dynamic Lowering Circuit Controller," is of the magnetic contactor type and is intended for use on crane, ore and coal bridge and bucket hoists.

Dynamic braking hoist controllers have hitherto been open to the objection that the release of the solenoid brake was sluggish in the lowering direction, making it necessary to pause on the first



point to give the brake an opportunity to release before advancing the controller, frequent brake adjustments being necessary to prevent entire failure of the brake to release.

With the new Wright dynamic lowering circuit, the brake releases instantly. Instead of passing only one-third of the line current through the brake on the first point lowering, this new circuit passes all of the line current through the brake. The operator no longer has to hesitate on the first step, he can move his master controller instantly to any desired speed point. Improper brake adjustment has little effect on this quick release.

This improvement insures faster crane operation, more accurate control of short, quick movements and better ability to spot loads, and is one of the many advantages of the new circuit.

Marion Shovel Bulletins

The Marion Steam Shovel Company has recently issued a new bulletin, No. 343, describing their line of Type 450, 1¼ cu. yd. excavators in electric, Diesel-electric and gas-electric powers. This 16-page bulletin illustrates in detail the advanced construction of Marion small revolving electric powered excavating equipment. A similar bulletin, No. 339, has just been issued on the Type 450 steam machines.

A new bulletin, No. 343, has also been published illustrating and describing the Type 490 electric heavy-duty quarry or coal loading shovel. The Type 490 has a dipper capacity of 2¼ and 3 cu. yds., depending on its use as a quarry shovel or coal loader.

Copies of any of these bulletins may be obtained by writing direct to the company at Marion, Ohio.

New Morse Book Rich in Needed Information

One of the most interesting of the books that has recently come to the attention of the editors is the new 24-page bulletin gotten out by the Morse Chain Company on the subject of flexible couplings, a device that is coming into a position of increasing importance in the industrial world, and the Morse Chain Company in their new bulletin No. 37 completely outline its uses and advantages.

The subject of flexible couplings is very thoroughly gone into from every angle, and many points which have hitherto been debatable ones in the average manufacturer's mind are cleared up in a remarkably common-sense manner. The reading matter starts with the development of the need for flexibility in modern scientific power transmission, and takes up successively such vital and interesting subjects as savings effected on bearings and machinery, lowering maintenance costs, and so forth. The principle of Morse Flexible Coupling design is explained, together with the methods of installing and employing them, which includes two pages of installation photographs, starting with the bare shaft ends, and ending with the coupling in place, ready to run. This section is also augmented by two pages of photos of typical installations on machines.

Complete data is also given on the proper way to select couplings, their ratings, dimensions, and prices. These first are grouped according to horsepower used, while two succeeding pages contain all the couplings grouped according to pitch. Speed reducers are also explained, as is the Morse Power Transmisssion Service, and a specification blank with a mailing card calling for the free data file are both enclosed.

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GENERAL OFFICES
14 Reiber Building,
Butler, Pa.
Telephone 3731

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ENTERPRISE
ARGENTINE
ERICO
SWARTZLANDER
PLUMVILLE

DISTRICT OFFICES
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1024 Prudential Building
Telephone Wash. 1961-2

New York
One Broadway
Telephone Digby 1350

Albany, N. Y.
74 Chapel St.
Telephone 36956

WILDWOOD MINE

On main line of Baltimore & Ohio Railroad, in the Pittsburgh District
Daily capacity—8,000 tons
Plant designed and built by Allen & Garria Co.
Equipment—Shaker Screens, Picking Tables, Loading Booms
Perle-Davis Air-cleaning Plant
Thick Vein Freeport Seam
Sizes shipped—Run of Mine, 4" Lump, 3" Lump, 2" Lump, ¾" Lump
2"x4" Egg, ¾"x2" Nut, 2" Nut Slack, ¾" Slack
Shipping Point—Wildwood, Pa.

KINCAID MINE

On Western Allegheny R. R.
Shipping Point—Karns City, Pa.
Way-Billing Point—Queen Jct., Pa.
Upper Freeport Seam
Equipment—Shaker Screens, Picking Table, Loading Boom
Sizes Shipped—Run of Mine, 1¼" Lump, ¾" Lump, 1¼" Nut and Slack, ¾" Slack.
Daily Capacity—1,000 Tons

ARGENTINE MINE (KEYSTONE No. 5)

On Hilliard Branch of Bessemer and Lake Erie R. R.
Shipping Point—Argentine, Pa.
Way-Billing Point—Branchton, Pa.
Brookville Seam
Equipment—Shaker Screens, Picking Table, Loading Boom
Sizes Shipped—Run of Mine, 4" Lump, 3" Lump, 2" Lump, 1½" Lump, 2" Nut and Slack, 1½" Nut and Slack; also Egg, Stove or Nut in any size.
Daily Capacity—500 Tons

ENTERPRISE MINE

On Mt. Jewett Branch of Baltimore and Ohio R. R.
Shipping Point—Karns City, Pa.
Way-billing Points—Butler, Pa., or Clarion Jct. Pa.
Upper Freeport Seam
Sizes Shipped—Run of Mine
Daily Capacity—400 Tons

PLUMVILLE MINE

On Buffalo and Susquehanna R. R.
Shipping Point—Plumville, Pa.
Way-billing Point—Du Bois, Pa.
Upper Freeport Seam
Equipment—Shaker Screens, Picking Table, Loading Boom
Sizes Shipped—Run of Mine, 5" Lump, 4" Lump, 3" Lump, 1½" Lump, 1½" Nut and Slack; Egg, Stove or Nut in any size.
Daily Capacity—300 Tons

ERICO MINE (KEYSTONE No. 3)

On Hilliard Branch of Bessemer and Lake Erie R. R.
Shipping Point—Erico, Pa.
Way-billing Point—Branchton, Pa.
Brookville Seam
Equipment—Shaker Screens, Picking Table, Loading Boom
Sizes Shipped—Run of Mine, 4" Lump, 3" Lump, 2" Lump, 1½" Lump, 2" Nut and Slack, 1½" Nut and Slack; also Egg, Stove or Nut in any size
Daily Capacity—500 Tons

SWARTZLANDER MINE

On Buffalo, Rochester and Pittsburgh Ry.
Shipping Point—Fenelton, Pa.
Way-Billing Points—Cloe, Pa., or Butler Jct. Pa.
Lower Freeport Seam
Sizes Shipped—Run of Mine
Daily Capacity—200 Tons

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T. C. Mullins, *President*

F. W. Kane, *Vice President*

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Prest-O-Lite Co., Inc.

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Ingersoll-Rand Co.

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ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co.

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Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC CAR DUMPERS
Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC FLAGGING SIGNALS
American Mine Door Co.

AUTOMATIC (Mine Doors, Trucks and Electric Switches)
American Mine Door Co.

AUTOMATIC MINE SWITCHES
Westinghouse Electric & Mfg. Co.

AUTOMATIC SWITCH THROWERS
American Mine Door Co.
Westinghouse Electric & Mfg. Co.

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Keystone Lubricating Co.

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American Coal Cleaning Corpn.

BALLAST UNLOADER ROPES
Roebling's Sons Co., J. A.

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Timken Roller Bearing Co.

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Westinghouse Electric & Mfg. Co.

BATTERIES, Blasting
Hercules Powder Co.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
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Westinghouse Electric & Mfg. Co.

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Atlas Car & Mfg. Co.

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BEARINGS, RADIAL
Timken Roller Bearing Co.

BEARINGS, TAPERED ROLLER
Timken Roller Bearing Co.

BEARINGS, THRUST
Timken Roller Bearing Co.

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Standard Oil Co. (Ind.)

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Link-Belt Co.

BELTING, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

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The Jeffrey Mfg. Co.
Link-Belt Co.

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Mine Safety Appliances Co.

BITS, Carbon (Diamonds) for Core Drill
R. S. Patrick.
Diamond Drill Carbon Co.

BITS, Diamond Drilling
R. S. Patrick.

BIT SHARPENERS
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Ingersoll-Rand Co.

BLACK DIAMONDS
Diamond Drill Carbon Co.
R. S. Patrick.

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Hercules Powder Co.

BLASTING MACHINES
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Hercules Powder Co.

BLASTING POWDER
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Hercules Powder Co.

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Hercules Powder Co.

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Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

BLOWERS (or Compressors)
General Electric Co.

BLOWERS (Tubing)
The Jeffrey Mfg. Co.
Robinson Ventilating Co.

BLOWERS (Turbine)
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

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Diamond Drill Carbon Co.

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Central Frog & Switch Co.

BRACES, RAIL
Central Frog & Switch Co.

BRACES, TRACK
Central Frog & Switch Co.

BRAZILIAN ROCK CRYSTAL
Diamond Drill Carbon Co.

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Goodman Mfg. Co.

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Vulcan Iron Works.

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Mine Safety Appliances Co.

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CABLE—ELEVATOR, MACHINE, ETC. (STEEL)
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CABLE GREASE
Keystone Lubricating Co.

CABLE—HOISTING
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CABLE — MINING (HAULAGE, SHAFT HOIST, MINING MACHINE, SLUSHER)
American Cable Co.

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CABLES, SUSPENSION BRIDGE
American Cable Co.
Roebling's Sons Co., J. A.

CABLEWAYS
American Steel & Wire Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CABLE—WIRE
American Cable Co.

CAGE DUMPERS, ROTARY
Link-Belt Co.
Roberts & Schaefer Co.

CAGES (Safety Appliances)
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Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC
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Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC & MANUAL
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Mining Safety Device Co.
Roberts & Schaefer Co.

CAGES
Allis-Chalmers Mfg. Co.
C. S. Card Iron Works Co.
Connellsville Mfg. & Mine Sup. Co.
Robt. Holmes & Bros., Inc.
Link-Belt Co.
United Iron Works, Inc.
Vulcan Iron Works.

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Link-Belt Co.
Roberts & Schaefer Co.
Vulcan Iron Works.

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Vulcan Iron Works.

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CASTINGS, OPEN HEARTH, STEEL
Vulcan Iron Works.

CASTINGS (Steel, Iron)
Vulcan Iron Works.

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Morse Chain Co.

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Morse Chain Co.

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CHAINS, DRIVE
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The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CHAINS, FRONT END
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Morse Chain Co.

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CHAINS, OILING
Morse Chain Co.

CHAINS, POWER TRANSMISSION
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Morse Chain Co.

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CHAINS, SILENT (Rocker-Joint)
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CHAINS, SLING
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Morse Chain Co.

CHAINS, SPROCKET WHEEL
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The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

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Ludlow Saylor Wire Co.

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The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

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Conveyor Sales Co.
Link-Belt Co.

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Link-Belt Co.

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Link-Belt Co.
Vulcan Iron Works.

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Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.
Westinghouse Electric & Mfg. Co.

COAL LOADERS
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Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Sullivan Machinery Co.

COAL MINING MACHINERY
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Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Sullivan Machinery Co.
Westinghouse Electric & Mfg. Co.

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Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

COAL PREPARATION MACHINERY
American Coal Cleaning Corpn.
Link-Belt Co.
Roberts & Schaefer Co.

COAL SEPARATING MACHINERY
W. S. Tyler Co.

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Roberts & Schaefer Co.

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COAL TESTING EQUIPMENT
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Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co.
Sullivan Machinery Co.

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CONCRETE REINFORCEMENT
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The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

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Westinghouse Electric & Mfg. Co.

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Conveyor Sales Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.

CONVEYOR BEARINGS
Link-Belt Co.

CONVEYORS, BELT
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, CHAIN FLIGHT
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, COAL
American Coal Cleaning Corpn.
Conveyor Sales Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

CONVEYORS AND ELEVATORS
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American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, PAN OR APRON
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, SCREW
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

COOLERS (Man)
Robinson Ventilating Co.

COOLERS, ROTARY
Vulcan Iron Works.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CORDS—SASH, STEEL WIRE
American Cable Co.

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick.

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CROSSINGS AND CROSSOVERS
C. S. Card Iron Works Co.
Central Frog & Switch Co.
West Virginia Rail Co.

CROSSOVERS
Central Frog & Switch Co.

CROSS TIES, CREOSOTE TREATED
Ayer & Lord Tie Co.

CRUSHER OILS
Standard Oil Co. (Ind.)

CRUSHERS
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
United Iron Works, Inc.

CRUSHERS (Coal)
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

CRUSHERS, SINGLE and DOUBLE ROLL
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Co.
Link-Belt Co.

CRYSTAL (Quartz)
Diamond Drill Carbon Co.

CUP GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co.

CYCLONE DUST COLLECTORS
American Coal Cleaning Corpn.

DECARBONIZING APPARATUS
Oxweld Acetylene Co.

DESIGNERS OF PLANTS
American Coal Cleaning Corpn.
Koppers-Rheolaveur Co.
Link-Belt Co.
Roberts & Schaefer Co.

DETONATORS
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

DIAMOND CORE DRILL CONTRACTING
Hoffman Bros. Drilling Co.
Sullivan Machinery Co.

DIAMOND DRILLING CARBON
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMONDS, BLACK (See Carbon and Bortz)
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMONDS, INDUSTRIAL
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMOND TOOLS
Diamond Drill Carbon Co.

DIESEL ENGINE OILS
Standard Oil Co. (Ind.)

DIGGERS & PICKS (Pneumatic)
Ingersoll-Rand Co.

DOORS, AUTOMATIC MINE
American Mine Door Co.

DRIFTERS, DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILLERS' DIAMONDS
Diamond Drill Carbon Co.

DRILLING CONTRACTORS
Pennsylvania Drilling Co.
Sullivan Machinery Co.

DRILLING, DIAMONDS for
Diamond Drill Carbon Co.
R. S. Patrick.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co.

DRILLS (Blast Hole)
Ingersoll-Rand Co.

DRILL BITS, Carbon (Diamonds) for
Diamond Drill Carbon Co.
R. S Patrick.

DRILL, CARBON (Diamonds) for
Diamond Drill Carbon Co.
R. S. Patrick.

DRILL COLUMNS & MOUNTINGS
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILL LUBRICANTS
Standard Oil Co. (Ind.)

DRILLER'S DIAMONDS
R. S. Patrick.

DRILLS, CORE
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.

DRILLS, ELECTRIC
General Electric Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

DRILLS, HAMMER
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILLS (Hand Operated Coal)
Ohio Brass Co.

DRILLS, PNEUMATIC
Ingersoll-Rand Co.

DRILLS, PROSPECTING
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.

DRILLS, ROCK
General Electric Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRIVES, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co.
Robt. Holmes & Bros., Inc.
Link-Belt Co.
Vulcan Iron Works.

DRY CLEANING COAL & COKE
American Coal Cleaning Corpn.
Link-Belt Co.
Roberts & Schaefer Co.

DRYERS, ROTARY
Vulcan Iron Works.

DUMP CARS
Atlas Car & Mfg. Co.
Connellsville Mfg. & Mine Supply Co.,

DUMPS
United Iron Works, Inc.

DUMPS (Rotary, Cradle, Crossover & Kickback)
C. S. Card Iron Works Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

DUST COLLECTING EQUIPMENT
American Coal Cleaning Corpn.

DUST FILTERS
American Coal Cleaning Corpn.

DYNAMITE
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

DYNAMOS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.

DYNAMO OILS
Standard Oil Co. (Ind)

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRICAL CABLES & WIRES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

ELECTRIC BLASTING CAPS
Hercules Powder Co.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co.

ELECTRIC LOCOMOTIVES
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC LOCOMOTIVE CABLES
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

ELECTRIC MINE SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC WIRES AND CABLES
General Electric Co.
American Steel & Wire Co.

ELECTRICAL SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRICAL WIRES AND CABLES
Roebling's Sons Co., J. A.

ELECTRODES, WELDING
Roebling's Sons Co., J. A.

ELEVATORS
The Jeffrey Mfg. Co.
Link-Belt Co.

ELEVATORS, BUCKET
The Jeffrey Mfg. Co.
Link-Belt Co.

ELEVATOR CABLES & ROPES
Roebling's Sons Co., J. A.

ELEVATOR AND HOIST MOTORS
Westinghouse Electric & Mfg. Co.

ELEVATOR MACHINERY
Atlas Car & Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

ENGINE OILS
Standard Oil Co. (Ind.)

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co.
Robt. Holmes & Bros., Inc.
Westinghouse Electric & Mfg. Co.

ENGINES, OIL
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.

ENGINES, STEAM
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.

EXCAVATORS
Link-Belt Co.

EXHAUSTERS
American Coal Cleaning Corpn.

EXPLOSIVES
The E. I. du Pont Powder Co.
Hercules Powder Co.

FAN DRIVES
Link-Belt Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

FANS, Man Cooling
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

FANS, Turbine
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

FEEDERS
Hockensmith Wheel & Mine Car Co.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

FEEDERS (Gravity)
American Coal Cleaning Corpn.
Link-Belt Co.

FEEDERS (Hand Operated)
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

FEEDERS, ORE
The Jeffrey Mfg. Co.
Link-Belt Co.

FEEDERS (Reciprocating)
Robt. Holmes & Bros., Inc.
Link-Belt Co.
American Coal Cleaning Corpn.

FEEDERS (Semi-automatic)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.

FIBRE GREASES
Standard Oil Co. (Ind.)

FILTER CLOTH, WIRE
Ludlow Saylor Wire Co.

FILTERS (Dust)
American Coal Cleaning Corpn.

FIRE AND WEATHER-PROOF WIRE
Roebling's Sons Co., J. A.

FIRST AID SUPPLIES
Mine Safety Appliances Co.

FITTINGS—WIRE ROPE (Tru-Loc Brand Processed)
American Cable Co.

FITTINGS—WIRE ROPE (Thimbles, Clips, Sockets, Hooks, Shackles Turnbuckles)
American Cable Co.

FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co.

FLOTATION OILS
Hercules Powder Co.

FLOW METERS
General Electric Co.

FLUX, WELDING
Oxweld Acetylene Co.

FORGINGS
Allis-Chalmers Mfg. Co.

FROGS
Central Frog & Switch Co.

FROGS AND SWITCHES
C. S. Card Iron Works Co.
Central Frog & Switch Co.
West Virginia Rail Co.

FURNACE OIL
Standard Oil Co. (Ind.)

FURNACES, Oil (for drill steel)
Ingersoll-Rand Co.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc.

GAS (Nitrogen, Oxygen)
Linde Air Products Co.

GASOLINE
Standard Oil Co. (Ind.)

GAS ENGINE OILS
Standard Oil Co. (Ind.)

GAS MASKS
Mine Safety Appliances Co.

GAUGES, WELDING & CUTTING
Central Frog & Switch Co.

GAUGE RODS
Central Frog & Switch Co.

GAUGES, WELDING & CUTTING
Oxweld Acetylene Co.

GEAR COMPOUNDS
Standard Oil Co. (Ind.)

GEARS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

GEARS, BEVEL
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

GEARS (Fabroil & Textolite)
General Electric Co.

GEARS, HERRINGBONE
Link-Belt Co.
Vulcan Iron Works.

GEARS, Machine Cut
Link-Belt Co.
Vulcan Iron Works.

GEARS, Moulded Tooth
Link-Belt Co.
Vulcan Iron Works.

GEARS, Silent Chain
Link-Belt Co.
Morse Chain Co.

GEARS, SPUR
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

GEARS, WORM
The Jeffrey Mfg. Co.

GELATIN DYNAMITES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.

GENERATORS, ACETYLENE
Oxweld Acetylene Co.

GLOVES, ASBESTOS
Oxweld Acetylene Co.

GOGGLES, MINERS' WIRE SCREEN, NOD AND SHAKE WELLSWORTH
Mine Safety Appliances Co.

GOGGLES, WELDING
Oxweld Acetylene Co.

GRAPHITE GREASES
Standard Oil Co. (Ind.)

GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

GREASE CUPS
Keystone Lubricating Co.

GRINDERS, Portable Pneumatic
Ingersoll-Rand Co.

GUARD RAIL CLAMPS
Central Frog & Switch Co.

GUY ROPES, GALVANIZED
American Steel & Wire Co.
Roebling's Sons Co., J. A.

HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co.

HANGERS
Link-Belt Co.

HANGERS (Insulated Trolley)
Ohio Brass Co.

HANGERS, SHAFT, DROP
Link-Belt Co.

HANGERS, SHAFT, POST
Link-Belt Co.

HANGERS, SHAFT, SELF-OILING
Link-Belt Co.

HAULAGE ROPE
American Steel & Wire Co.
Roebling's Sons Co., J. A.

HEADLIGHTS, ARC AND INCANDESCENT
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

HEATER CORD
Roebling's Sons Co., J. A.

HERRINGBONE GEAR DRIVES
Link-Belt Co.

H-H INHALATORS
Mine Safety Appliances Co.

HIGH EXPLOSIVES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.

HOIST DRIVES
Link-Belt Co.
Vulcan Iron Works.

HOISTING ROPES
American Steel & Wire Co.
Connellsville Mfg. & Mine Supply Co.
Roebling's Sons Co., J. A.

HOISTS
American Steel & Wire Co.
Ingersoll-Rand Co.
Link-Belt Co.
Sullivan Machinery Co.
United Iron Works, Inc.

HOISTS, AIR
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
General Electric Co.
Goodman Mfg. Co.
Sullivan Machinery Co.
Vulcan Iron Works

HOISTS, PORTABLE
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, Room
Vulcan Iron Works.

HOISTS, Room and Gathering
Goodman Mfg. Co.

HOISTS, Scraper-Loader
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, STEAM
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Robt. Holmes & Bros., Inc.
Ingersoll-Rand Co.
Vulcan Iron Works.

HOLDERS-ON RIVETING
Ingersoll-Rand Co.

HOOKS
Roebling's Sons Co., J. A.

HOOKS, WIRE ROPE
American Cable Co.

HOSE, AIR AND STEAM
Ingersoll-Rand Co.

HOSE, WELDING AND CUTTING
Oxweld Acetylene Co.

HYDRATORS, LIME
Vulcan Iron Works.

IGNITERS, Electric
Hercules Powder Co.

INCINERATORS
Vulcan Iron Works.

INCLINE FROGS
Central Frog & Switch Co.

INCLINE TRACK LAYOUTS
Central Frog & Switch Co.

INSULATORS, FEEDER WIRE
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS, SECTION
American Mine Door Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS (Porcelain)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS (Third Rail)
General Electric Co.
Ohio Brass Co.

INSULATORS (Trolley)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATED WIRE AND CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

KEROSENE
Standard Oil Co. (Ind.)

KEYSTONE GREASE
Keystone Lubricating Co.

KEYSTONE GREASE CUPS
Keystone Lubricating Co.

KEYSTONE SAFETY LUBRICATORS
Keystone Lubricating Co.

KILNS (Rotary)
Allis-Chalmers Mfg. Co.
Vulcan Iron Works.

KILNS, VERTICAL
Vulcan Iron Works.

LAMP CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.

LAMPS, ARC AND INCANDESCENT
General Electric Co.
Westinghouse Electric & Mfg. Co.

LAMPS (Edison Electric)
Mine Safety Appliances Co.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co.

LIGHT AND POWER PLANTS (Small)
Westinghouse Electric & Mfg. Co.

LIGHT STEEL ANGLES
Carnegie Steel Co.

LIGHT STEEL RAILS
Carnegie Steel Co.
West Virginia Rail Co.

LOADERS, Gravel and Sand
Joy Manufacturing Co.
Link-Belt Co.

LOADERS (Mine Car)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.

LOADERS, PORTABLE
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.

LOADERS, Snow
Joy Manufacturing Co.

LOADERS, Truck
Joy Manufacturing Co.
Link-Belt Co.

LOADERS, Wagon
Joy Manufacturing Co.
Link-Belt Co.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co.
Robt. Holmes & Bros., Inc.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co.
Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Myers-Whaley Co.

LOCOMOTIVES, ELECTRIC
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVES, GASOLINE
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVES, RACK RAIL
Atlas Car & Mfg. Co.
Goodman Mfg. Co.

LOCOMOTIVES, STEAM
Vulcan Iron Works.

LOCOMOTIVES, STORAGE BATTERY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVE SWITCHING & WRECKING ROPES
Roebling's Sons Co., J. A.

LOCOMOTIVES (Third Rail)
Atlas Car & Mfg. Co.
Goodman Mfg. Co.

LOCOMOTIVES, TROLLEY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LONGWALL MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.

LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

LUBRICATING DEVICES
Keystone Lubricating Co.

LUBRICATING GREASES
Keystone Lubricating Co.

LUBRICATING ENGINEERS
Keystone Lubricating Co

LUBRICATORS
Keystone Lubricating Co.
MACHINE OILS
Standard Oil Co. (Ind.)
MACHINERY, TRANSMISSION (Power)
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Morse Chain Co.
MANIFOLDS, OXYGEN
Oxweld Acetylene Co.
MAST ARM ROPE, Galvanized
Roebling's Sons Co., J. A.
METHANE RECORDER, CONTINUOUS
Mine Safety Appliances Co.
MILL GREASES
Standard Oil Co. (Ind.)
MILLS, ROD & BALL
Allis-Chalmers Mfg. Co.
MILLS, STAMPS
Allis-Chalmers Mfg. Co.
MINE CAR AXLES
Hockensmith Wheel & Mine Car Co.
MINE CAR BEARINGS
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.
MINE CAR BOXES
Hockensmith Wheel & Mine Car Co.
MINE CAR FORGINGS
Hockensmith Wheel & Mine Car Co.
MINE CAR LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)
MINE CAR PARTS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
MINE CARS
Atlas Car & Mfg. Co.
C. S. Card Iron Works Co.
Enterprise Wheel & Car Corpn.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
United Iron Works, Inc.
MINE CAR TRUCKS
United Iron Works, Inc.
MINE CAR WHEELS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
United Iron Works, Inc.
MINE DOORS, AUTOMATIC
American Mine Door Co.
MINE LOCOMOTIVE CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
MINE TIES
Central Frog & Switch Co.
MINE TIES, CREOSOTE TREATED
Ayer & Lord Tie Co.
MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING EQUIPMENT
Allis-Chalmers Mfg. Co.
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINE CABLE
General Electric Co.
Roebling's Sons Co., J. A.
MINING MACHINES
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.
MINING MACHINES (Electric)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINES (Government Approved)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
MINING MACHINERY
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINERY BEARINGS
Hyatt Roller Bearing Co.
MINING MACHINERY LUBRICANTS
Keystone Lubricating Co.
MINING MACHINE ROPES
American Cable Co.
MINING POSTS, CREOSOTE TREATED
Ayer & Lord Tie Co.
MINING ROPES (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.
MINING TIMBERS, CREOSOTE TREATED
Ayer & Lord Tie Co.
MOTOR OILS
Standard Oil Co. (Ind.)
MOTORS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.
MOTORS, Electric
Westinghouse Electric & Mfg. Co.
MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co.
MOVING PICTURE CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.
NITROGEN GAS
Linde Air Products Co.
OILS
Standard Oil Co. (Ind.)
ORE, BUYERS AND SELLERS OF
Irvington Smelt. & Ref. Works.
OVERCUTTING MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.
OXYGEN GAS
Linde Air Products Co.
OXYGEN BREATHING APPARATUS, McCAA TWO-HOUR
Mine Safety Appliances Co.
OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co.
PAVING BREAKERS
Ingersoll-Rand Co.
Sullivan Machinery Co.
PERFORATED METAL
Allis-Chalmers Mfg. Co.
PERMISSIBLES, Explosives
The E. I. Du Pont Powder Co.
Hercules Powder Co.
PETROLATUMS
Standard Oil Co. (Ind.)
PICKING TABLES
Robt. Holmes & Bros., Inc.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.
PIPE (Genuine Wrought Iron)
A. M. Byers Co.
PIPE (Wood)
Connellsville Mfg. & Mine Supply Co.
PNEUMATIC COAL SEPARATING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC SIZING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC TOOL
Ingersoll-Rand Co.
PNEUMATIC TOOL LUBRICANT
Standard Oil Co. (Ind.)
PORTABLE TRACK
Central Frog & Switch Co.
PORTABLE TURNOUTS
Central Frog & Switch Co.
POSTS, CREOSOTE TREATED
Ayer & Lord Tie Co.
POWDER, BLASTING
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.
POWER CABLES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
POWER SHOVELS
Link-Belt Co.
POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.
Westinghouse Electric & Mfg. Co.
PREHEATING APPARATUS
Oxweld Acetylene Co.
PRESSURE GUN GREASE
Standard Oil Co. (Ind.)
PROSPECTIVE DRILLS
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.
Pennsylvania Drilling Co.
PULLEYS
Link-Belt Co.
PULLEYS, CLUTCH, FRICTION
Link-Belt Co.
PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Co.
PUMPS, Acid Resisting
Ingersoll-Rand Co.
PUMPS, AIR LIFT
Ingersoll-Rand Co.
Sullivan Machinery Co.
PUMPS, Boiler Feed
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.
PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, DEEP WELL
Ingersoll-Rand Co.
PUMPS (Electric)
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
Westinghouse Electric & Mfg. Co.
PUMPS, Fire
Ingersoll-Rand Co.
PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co.
PUMPS, Inclined Shaft
Ingersoll-Rand Co.
PUMPS, MINE
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, Sinking
Ingersoll-Rand Co.
PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co.
PUMPS, POWER
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, VACUUM
Ingersoll-Rand Co.
PUNCHES, Drill Steel
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARRYING MACHINERY
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARTZ CRYSTAL
Diamond Drill Carbon Co.
RAIL BONDS
American Steel & Wire Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
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Central Frog & Switch Co.
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Mining Safety Device Co.
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Roberts & Schaefer Co.
ROCK DOORS
United Iron Works, Inc.
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Ingersoll-Rand Co.
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American Steel & Wire Co.
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ROPE, WIRE (Crescent Brand Ordinary)
American Cable Co.
ROPE, WIRE (Plain or Galvanized)
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C. S. Card Iron Works Co.
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Mining Safety Device Co.
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ROTARY ROASTERS
Vulcan Iron Works.
RUNNING ROPE, Galvanized
American Steel & Wire Co.
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E. I. Du Pont de Nemours & Co.
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Keystone Lubricating Co.
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Roebling's Sons Co., J. A.
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Ingersoll-Rand Co.
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Goodman Mfg. Co.
Sullivan Machinery Co.
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Phillips Mine & Mill Supply Co.
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United Iron Works, Inc.
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American Coal Cleaning Corpn.
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INDEX TO ADVERTISERS

The COPPER Industry

The Copper Industry Number of THE MINING CONGRESS JOURNAL will appear in April. It will present a comprehensive review of the status, operating conditions and recent progress in method of mining and refining. Thirty articles in particular will feature specifically a complete story of

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- Open Pit Mining
- Ventilation
- Historical Growth of Smelting Plant
- Reverberatory Smelting
- Blast Furnace Smelting
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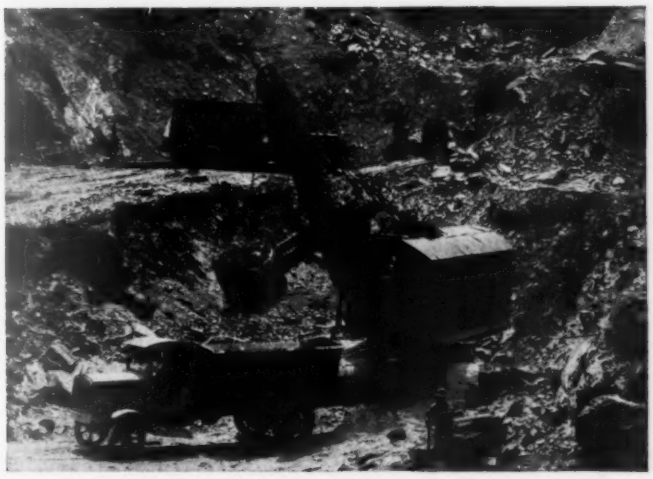

April Issue

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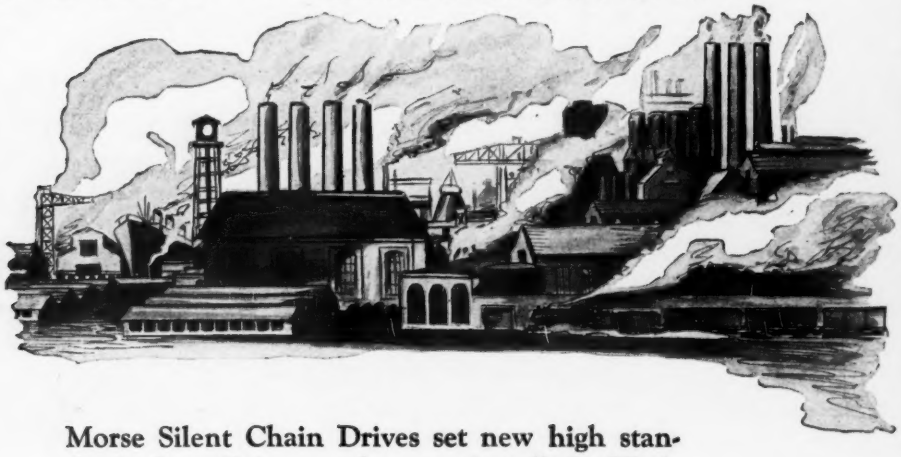

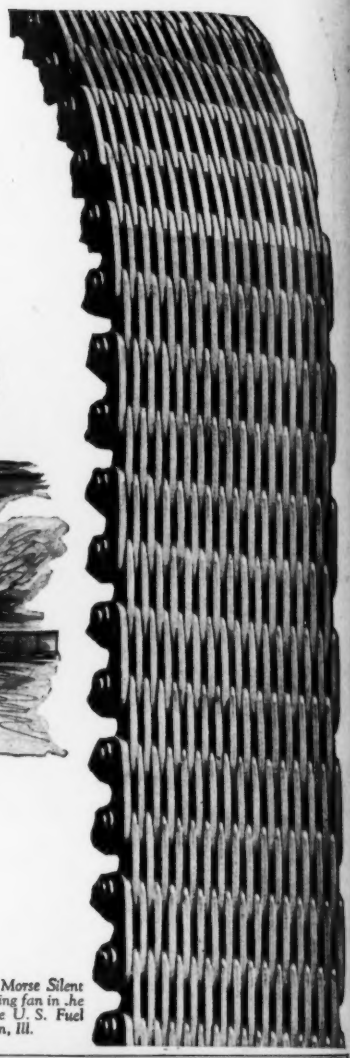

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